

Artificial Intelligence

\$3.00

9/23/86  
PRICE  
300  
6FX

# MICRO CORNUCOPIA

The  
Micro Technical Journal



June-July 1986

No. 30

## Special AI Issue

**PROLOG On The PC** .....6  
*A thorough comparison of PROLOGS available on the PC.*

**Expert Systems and Logic Programming** .....12  
*Expert systems designers are handing out numbers to prospective customers.*

**Opening Bids In Bridge** .....18  
*A great example of how AI works. Grab your PROLOG and start coding.*

## And More

**Building Your Own Logic Analyzer** .....26  
*Can't afford a commercial 32-channel logic analyzer? You can afford this one.*

**86 World** .....36  
*Our man in Turkey trots all over Asia looking for the complete supplier of drives, systems, boards.*

**256K RAM For Your 83 Kaypro** .....44  
*Finally, a do-it-yourself RAM upgrade for this venerable Z80 machine.*

**PC-DOS For Non-Clones** .....54  
*Write a PC BIOS for your 8086-8088 system.*






Step-by-step tutorial, demo programs with source code included!

# Borland introduces Turbo Prolog, the natural language of Artificial Intelligence.

Prolog is probably the most powerful computer programming language ever conceived, which is why we've made it our *second* language—and "turbocharged" it to create Turbo Prolog."

Our new Turbo Prolog brings supercomputer power to your IBM® PC and introduces you step-by-step to the fascinating new world of Artificial Intelligence. And does all this for an astounding \$99.95.




 **Turbo Prolog is to Prolog what Turbo Pascal® is to Pascal!**

Our Turbo Pascal astonished everyone who thought of Pascal as "just another language." We changed all that—and now Turbo Pascal is the de facto worldwide standard, with hundreds of thousands of enthusiasts and users in universities, research centers, schools, and with professional programmers, students, and hobbyists.

You can expect at least the same impact from Turbo Prolog, because while Turbo Prolog is the most revolutionary and natural programming language, it is also a complete development environment—just like Turbo Pascal.

Turbo Prolog radically alters and dramatically improves the brave new world of artificial intelligence—and invites you into that fascinating universe for a humanly intelligent \$99.95.

 **Even if you've never programmed before, our free tutorial will get you started right away**


You'll get started right away because we have included a complete step-by-step tutorial as part of the 200-page Turbo Prolog Reference Manual. Our tutorial will take you by the hand and teach you everything you're likely to need to know about Turbo Prolog and artificial intelligence.

For example: once you've completed the tutorial, you'll be able to design your own expert systems utilizing Turbo Prolog's powerful problem-solving capabilities.

Think of Turbo Prolog as a high-speed electronic detective. First, you feed it information and teach it rules. Then Turbo Prolog "thinks" the problem through and comes up with all the reasonable answers—almost instantly.

If you think that this is amazing, you just need to remember that Turbo Prolog is a 5th-generation language—and the kind of language that 21st century computers will use routinely. In fact, you can compare Turbo Prolog to

Turbo Pascal the way you could compare Turbo Pascal to machine language.

 **You get the complete Turbo Prolog programming system for only \$99.95**

You get a complete Turbo Prolog development system including:

- The lightning-fast Turbo Prolog incremental compiler and the interactive Turbo Prolog editor.
- The 200-page reference manual which includes the step-by-step Turbo Prolog tutorial.
- The free GeoBase™ natural query language database including commented source code on disk—ready to compile. GeoBase is a complete database designed and developed around U.S. geography. It includes cities, mountains, rivers, and highways, and comes complete with natural query language. Use GeoBase immediately "as is," or modify it to fit your own interests.

So don't delay—don't waste a second—get Turbo Prolog now. \$99.95 is an amazingly small price to pay to become an immediate authority—an instant expert on artificial intelligence! The 21st century is only one phone call away.

## Turbo Prolog 1.0 Technical Specifications Programming System Features

- ☒ **Compiler:** Incremental compiler generating native in-line code and linkable object modules. The linking format is compatible with the PC-DOS linker. Large memory model support. Compiles over 2600 lines per minute on a standard IBM PC.
- ☒ **Interactive Editor:** The system includes a powerful interactive full-screen text editor. If the compiler detects an error, the editor automatically positions the cursor appropriately in the source code. At run-time, Turbo Prolog programs can call the editor, and view the running program's source code.
- ☒ **Type System:** A flexible object-oriented type system is supported.
- ☒ **Windowing Support:** The system supports both graphic and text windows.
- ☒ **Input/Output:** Full I/O facilities, including formatted I/O, streams, and random access files.
- ☒ **Numeric Ranges:** Integers: -32767 to 32767; Reals: 1E-307 to 1E+308
- ☒ **Debugging:** Complete built-in trace debugging capabilities allowing single stepping of programs.

# YES!

 I want the best

Turbo Prolog at only:

## \$99.95

To order by phone,  
or for a dealer nearest you,  
**Call (800) 255-8008**  
in CA call (800) 742-1133.

Send me ☐ Turbo Prolog at \$ \_\_\_\_\_

Outside USA add \$10 per copy  
CA and MA res. add applicable sales tax \$ \_\_\_\_\_

Amount enclosed: \$ \_\_\_\_\_

This price includes shipping to all US cities

Payment: ☐ VISA ☐ MC ☐ Bank Draft ☐ Check

Credit card expiration date: \_\_\_\_/\_\_\_\_

Card #

You must have an IBM or true compatible running DOS 2.0 or later.\*\*

My computer's name and model is: \_\_\_\_\_

The disk size I use is: ☐ 3 1/2" ☐ 5 1/4"

**NOT COPY PROTECTED  
\*60-DAY MONEY-BACK GUARANTEE**

Name: \_\_\_\_\_

Shipping Address: \_\_\_\_\_

City: \_\_\_\_\_

State: \_\_\_\_\_ Zip: \_\_\_\_\_

Telephone: \_\_\_\_\_

CODs and purchase orders WILL NOT be accepted by Borland. Outside USA make payment by credit card or International Postal Money Order.

\*YES, if within 60 days of purchase this product does not perform in accordance with our claims, please call our customer service department and we will gladly arrange a refund.

\*\* Minimum system requirements:  
IBM PC, XT, AT, PCjr,  
and true compatibles  
384K RAM  
SUS



4585 SCOTTS VALLEY DRIVE  
SCOTTS VALLEY, CA 95066  
(408) 438-8400 TELEFAX 172373

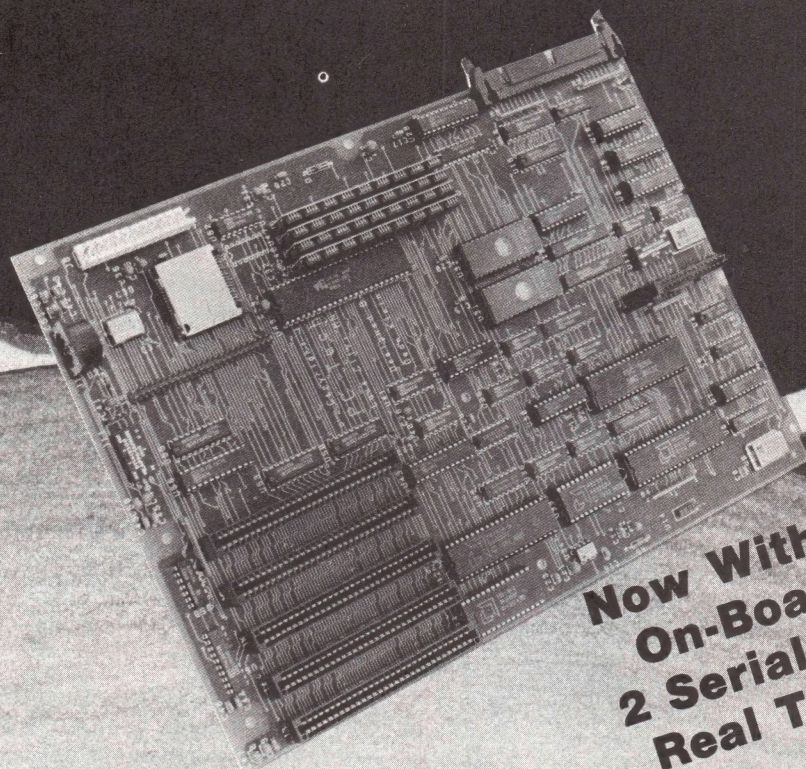
Other Borland Products include Turbo Pascal, Turbo Tutor, Turbo Lightning, Turbo Database Toolbox, Turbo Graphics Toolbox, Turbo Editor Toolbox, Turbo (GameWorks) SuperKey, SideKick, SideKick, The Macintosh Office Manager, Reflex, The Analyst, and Traveling SideKick—all of which are registered trademarks or trademarks of Borland International, Inc. or Borland/Analysis, Inc. Turbo Prolog and GeoBase are trademarks and Turbo Pascal is a registered trademark of Borland International Inc. IBM and AT are registered trademarks of International Business Machines Corp. Copyright 1986 Borland International. BI-1046D-MC





NEW  
LOWER \$

# the X-16B gives you Out of This World Performance



Now With Optional  
On-Board 8087  
2 Serial Ports, and  
Real Time Clock.

## PLUS PC COMPATABILITY!

### Features:

- 8 MHz 80186 microprocessor with true 16-bit data bus.
- True PC compatability with our own custom ROM BIOS and PC cardslots for the video of your choice.
- Standard 512K zero wait DRAM, or 1M options.
- 8087 numeric coprocessor support on board.
- On-board floppy disk controller for up to four 5 1/4" drives.
- On-board SCSI hard disk controller port. Supports WD1002 SHD, WD1003 ACS, OMTI 5100, 5300 ADAPTEC ACB 4000.
- 2 On-Board Serial Ports.
- Battery Back-Up Real Time Clock.

Designed, Manufactured and Serviced by:

**PCTECH**

P.O. Box 128  
904 North 6th Street  
Lake City, MN 55041  
(612) 345-4555

### Kits - All Wave Soldered!!

NEW LOWER  
PRICES

- Full Kit w/o SCSI, serial ports, clock ... \$ 550.00
- Assembled and Tested
  - W/O SCSI, serial ports, clock ... 1-4 \$ 599.00
  - 5-9 \$ 525.00
  - SCSI Port ..... add \$ 20.00
  - Serial Ports ..... each - add \$ 12.50
  - Real Time Clock and Battery add \$ 12.50
- 1/2 MEG Add-On ..... \$ 105.00
- XT Style, Enclosure ..... \$ 75.00
- 150 Watt Power Supply, Tested ... \$ 105.00
- 8087-2 Coprocessor ..... \$ Call

### Total Solutions:

#### Assembled and Tested Systems

- Mono-Chrome System ..... \$1,499.00  
Includes: 512K, Power Supply, Enclosure, Keyboard, Monitor, Two Drives, and Printer Port, 1 Serial Port, Real Time Clock.
- Quantity Discounts Upon Request
- Call For Info on Add-Ons, Hard Disks, Etc.

COD, VISA, MASTER CARD, CERTIFIED FUNDS



# MICRO CORNUCOPIA

The Micro Technical  
Journal

Editor & Publisher  
David J. Thompson

Operations & Advertising  
David Pogue

Associate Editors  
Rebecca Ozrelic Gary Entsminger

Accounting  
Sandra Thompson

Office Manager  
Tracey Anthony

Technical Department  
Larry Fogg

Staff Assistants  
Laura Logan Cary Gatton  
Renee Katter

MICRO CORNUCOPIA (ISSN 0747-587X) is published bi-monthly for \$16 per year by Micro Cornucopia Inc. 155 NW Hawthorne Bend, OR 97701. Second-class postage paid at Bend, OR and additional mailing offices. POSTMASTER: Send address changes to MICRO CORNUCOPIA, PO Box 223, Bend OR 97709.

#### SUBSCRIPTION RATES:

|                              |         |
|------------------------------|---------|
| 1 yr.(6 issues) .....        | \$16.00 |
| 2 yr.(12 issues) .....       | \$30.00 |
| 3 yr.(18 issues) .....       | \$42.00 |
| 1 yr.(Canada & Mexico) ..... | \$22.00 |
| 1 yr.(Other foreign) .....   | \$30.00 |

Make all orders payable in U.S. funds on a U.S. bank, please.

CHANGE OF ADDRESS: Please send your old label and new address.

MICRO CORNUCOPIA  
P.O. Box 223  
Bend, Oregon 97709

CUSTOMER SERVICE: For orders & subscription problems call 503-382-5060, 9 am to 5 pm, Pacific time, M - F.

For technical help call 503-382-8048, 9 am to noon, Pacific time, M - F.

RBBS - 24 hrs. 300-1200-2400 baud  
503-382-7643

Copyright 1986 by Micro Cornucopia Inc.  
All rights reserved  
ISSN 0747-587X

## EDITORIAL

By David Thompson

### Over The Wall

#### Morrow Computers Says Goodby

George Morrow is still around, but Morrow computers, one of the early powers in this industry, has filed Chapter 11.

In his book *Quotations From Chairman Morrow* George wrote, "Money is the only lethal drug available on a non-prescription basis."

"We pissed away \$11 million," he commented after the filing. (Something not experienced by many.)

If someone doesn't come forth shortly with something that's green and folds and interests bankers, there won't be another chapter.

#### Mirror Says A Lot

Be careful when you sue someone — you might just be doing them a favor. Crosstalk is suing Softklone over its Mirror communications package for the compatibles, but publicity from the suit could be a super boost for Softklone's new product.

I called Softklone to see what the fuss was about. It turns out that Mirror will emulate Crosstalk, from communications protocol to configuration files. Mirror will also speak Christianson (CRC or checksum), Hayes, and Kermit protocols.

It has a built-in text editor, password protection, data encoding/decoding, plus it runs in the background. (Just hit both shift keys and the transfer continues in the background while you use the system for other tasks. Hit the shifts again and you're back in Mirror.)

Mirror supports practically every auto or manual dial modem (Hayes compatible and non-compatible). It will even turn a PC into a VT-100 terminal if you wish.

I ordered one. After it arrived I tried it out on everything I could find. I'd been using Mite and Modem740, but I must say, this is better, much better. One problem I found is that it holds up the sender while it's writing to disk (in 4K blocks). At 9600 baud this delay becomes significant and reduces the effective transfer rate to about 5000 baud (running on a clone and writing onto a Seagate winchester).

However, at \$49.95 (not copy protected), it's definitely the best deal in commercial modem software I've seen.

#### Solid

I have a Holliston XT-186 board, and it's turned out to be a quick, very dependable performer. Though it doesn't have the video speed or the built-in floppy interface of PC Tech's X-16, it certainly holds its own in the processing



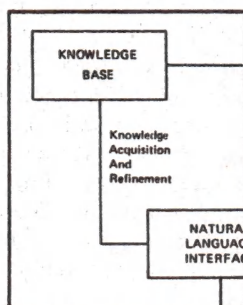
(continued on page 90)



## Introduction To PROLOG

- 6 PROLOG On The PC**  
*There's already quite a collection of compilers and interpreters for this unique new language*

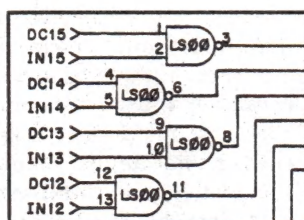
- 12 Expert Systems and Logic Programming**  
*An overview of expert systems design using PROLOG.*



- 18 Opening Bids In Bridge**  
*An example PROLOG application. Margaret Sklar lets her code do the talking.*

## More Features

- 26 Building Your Own Logic Analyzer**  
*Build your own logic analyzer for peanuts. Part one of a two-part series.*



- 54 PC-DOS For Non-Clones**  
*Want to write a custom PC BIOS for your 8088 system? Want to know what's happening inside your clone BIOS?*

- 72 Split Personalities-The V Series**  
*The V20 & V30 have been hot replacements for the 8088/86. What can the rest of the series do?*

- 68 The Racer's Edge**  
*The 68020 is out. Trevor Marshall and Co. tell us how it matches up against the 32032.*

- 94 Fast Step Rate For PC Disk Drives**  
*Larry Fogg changes his clone's step rate in software. An easy, quiet mod.*

## Columns

- 36 86 World**  
*Direct Importing. Laine picks up the baton and runs (all over Asia) with it. Fascinating adventure.*
- 44 Kaypro**  
*Folks have been requesting this mod for four years: an easy 256K RAM upgrade for the 83 Kaypro II and 4.*
- 48 Pascal Procedures**  
*John Jones tries writing a simple draw program for the PC (and enjoys it).*
- 64 C'ing Clearly Porting Code**
- 77 Culture Corner** *An answer for \$7.11.*
- 78 On Your Own AI recommendations**
- 82 In the Public Domain**  
*Another CP/M emulator, but this one thinks it's a Z80. How about that*
- 86 S-100 Bus Hardware supporting Turbodos**
- 96 Technical Tips**

## Future Tense

By Gary Entsminger

- 98 Tidbits** *File recovery under MS-DOS and the visible computer*
- 104 The Last Page** *It's recursion: again, and again, and again, and...*



# LETTERS

## Digs The Duck

I own a DAK ADC modem and have had basically good experiences. The only problem I encountered was that one of the DIP switches did not operate correctly. But since there was an equivalent command that I could imbed in my startup file, this was not a big problem.

I also found one little "gotcha" which I suspect is not limited to the duck. The modem will run in either 300 or 1200 baud over the phone line, depending on what it detects coming in. However, I found that when I dialed a BBS which handles both baud rates, the BBS tried 300 first. The duck obediently "quacked" at the lower rate after initially connecting at 1200. The solution is simple: turn off the buffered mode (ATB0) before dialing a BBS which you know will handle 1200 baud.

**Larry Blanchard**  
2018 N Valencia  
Santa Ana CA 92706

## Curing Keyboard Lockup

Several months ago a friend and I ordered speed-up mods and Pro-8 monitor ROMs from you to upgrade our 2-83s. Using the instructions enclosed with the kits we had no trouble successfully completing the modifications to both machines.

After about a half hour of continuous operation my computer developed a case of the dreaded "keyboard lock-up syndrome." After several telephone calls to Micro C, Zilog chip dealers, and MicroSphere, and quite a few suggestions that sounded good but didn't work, I got my Issue 26 of Micro C. It contained a Technical Tip about an aluminum heatsink developed by an English doctor.

Installation complete, power on, everything looked good — until an hour had passed. Then my system was off to la-la land again. I called Micro C for the third time, and that time, I got to talk to Mr. Thompson. During our 10 or 15 minutes on the phone we covered a wide range of possibilities. But when I hung up, I had a clear idea of what I needed to do.

First I checked the power supply. No problem — steady 5.045 volts.

Next I hooked up a scope to pin 6 on the CPU to see what the new 5MHz signal looked like. The waveform was quite ragged on the uphill side. In addition, the amplitude was extremely low, just over 2 volts. Just for comparison, I checked the now unused 2.5MHz pin and was amazed at the difference. The wave had an amplitude of well over 5 volts and was clean and smooth in appearance. Since I didn't have a replacement for the 74LS293 (U86 on the Micro C schematic), which provides both the 2.5MHz and the 5MHz signal, I couldn't see if it was a bad chip. Instead, I picked a 4MHz signal from pin 6 on U87 and fed it to the CPU. Eureka!

After installing a switch to allow transfer from 2.5 to 4MHz, I left the computer on for about 10 hours. No failure, and no recurrence. Thanks.

**Martin Leichtung**  
HRC 4260 Kachemak Dr.  
Homer AK 99603

## Amiga Benchmarks

You asked for benchmarks on the Amiga in Issue 29; here are mine:

| Bench              | 1     | 2     | 3     |
|--------------------|-------|-------|-------|
| Amiga w/Int.       | 237.9 | 124.1 | 225.1 |
| Amiga w/Short Int. | 32.5  | 21.0  | 225.0 |

All times are in seconds and include floppy disk access time. I used Lattice C. The first times were done with the program as you listed it. The second times were generated with short (16-bit) integers.

Now I need some info from you: how do you protect your system in the event of a power supply failure? I just had a supply go out that cost me a motherboard and winchester, not to mention the supply. Fortunately the case and fan were just fine.

**Bob Gobeille**  
805 Laporte Ave  
Fort Collins CO 80521

## Editor's note:

Lance Rutallie also submitted benchmarks almost identical to yours (he also used Lattice C V3.02). It's interesting to see the benchmark comparisons between the Amiga and the Atari ST.

A hunkering of knowledgeable guestimators came up with a set of expected times for the Amiga that showed beyond a doubt that knowledgeable guestimators don't

know what they're guestimating. They expected the Amiga to blow away anything less than an 8MHz 80286, especially for screen I/O which is measured in bench 3.

See Issue 29 for benchmark details. Times are in seconds. All used 16-bit integers (short ints for Amiga). No speed optimization was used (like register vars) when compiling.

| Bench              | 1     | 2     | 3     |
|--------------------|-------|-------|-------|
| Amiga w/Int.       | 237.9 | 124.1 | 225.1 |
| Amiga w/Short Int. | 32.5  | 21.0  | 225.0 |
| Atari ST           | 28.0  | 18.0  | 35.5  |
| 6 MHz AT clone     | 11.2  | 7.4   | 34.2  |
| 4.77 MHz 8088      | 54.7  | 28.7  | 73.6  |
| 4 MHz Z80          | 478.2 | 244.6 | 39.0  |

As for power supplies, boy, you've got me. I've seen some of the cheapest switching power supplies from Taiwan put up with all kinds of electrical violence without complaint (and without damaging the system).

The old linear supplies (10-20lb 60Hz transformers and house-warming linear regulators) I have on my Big Boards weren't cheap, aren't small, and definitely aren't efficient but after almost 6 years they haven't eaten any processors.

## One Out Of Two Ain't So Good

My first order to DAK was satisfactory, although it took four weeks for delivery instead of Mr. Bollinger's four days. My second order, however, was a nightmare. The printer I received was a defective, used one that had already been sent back by a dissatisfied customer in Florida. I found his address label as well as a used candy wrapper in the "factory" packing. Parts of the case were missing, and the machine never would initialize.

Two calls to customer service went unanswered. When I finally got through, their reply was, "You may send the merchandise back for a refund (sans shipping fees both ways)." A certified letter to the president of the company produced no better results.

I believe companies which make mistakes should be willing to correct them at their cost instead of making the customer pay for those errors. Needless to say, I will never do business with DAK again.

**David Randles**  
P.O. Box 8461  
Medford OR 97504

(continued on page 88)



# THE CHALLENGER XT-186

## SINGLE BOARD COMPUTER

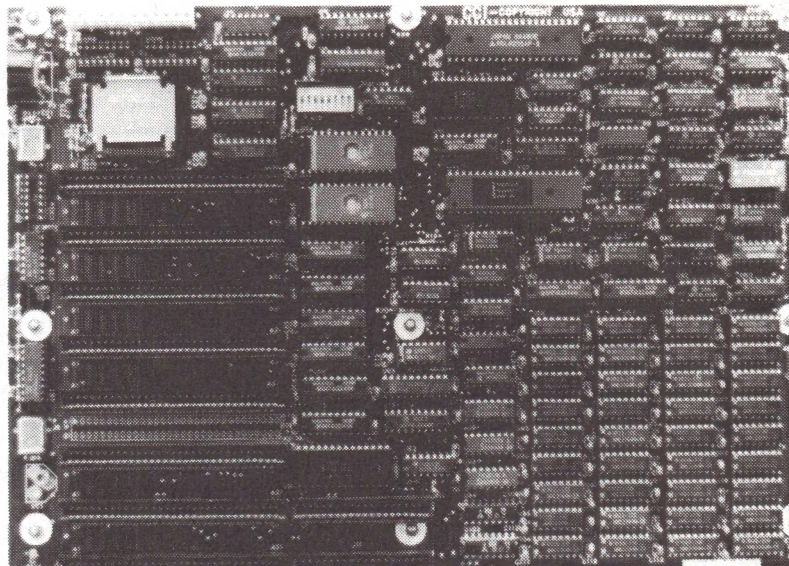
### FULLY IBM COMPATIBLE BUT FOUR TIMES FASTER

#### STANDARD FEATURES:

- Intel 80186 CPU, 8 MHz
- On-board 640K, parity checked RAM memory
- 8 slots for I/O Interface Board
  - 6 - 8 Bit Data
  - 2 - 16 Bit Data
- 4 channel 8237 DMA
- 8 channel 8259 Interrupt
- 3 channel 8253 Timer
- IBM PC-AT-like Bus with true 16 bit data path

#### OPTIONAL FEATURES:

- 10 MHz operation
- 8087 Numerical Processor Support
- **NEW** ROM BIOS Version 2.0



The Challenger XT-186 offers full IBM PC-XT compatibility. It supports industry standard operating systems: MS-DOS, PC-DOS, 1.0 through 3.1, CP/M and runs all existing software with higher performance. The XT-186 mother board can directly replace any existing PC or PC-XT mother board, as it has the same physical dimensions and mounting holes. The Intel 80186 and 640K on-board 16 bit path RAM makes the XT-186 the fastest PC currently available.

MOTHER BOARD, 8 MHz, 640K, RAM, 8 I/O slots

**NEW LOWER PRICE \$695.00**

The XT-186 ROM BIOS version 2.0 supports the IBM PC-T combined Hard Disk/Floppy Controller on the Challenger XT-186 mother board. With the new ROM BIOS installed the XT-186 can support two 1.2 MB floppy drives and two hard disk drives with the same fast access time of the IBM PC-AT. No other XT compatible system can offer either the speed or the disk storage capacity, (230 Mbytes maximum) of the XT-186.

XT-186 ROM BIOS version 2.0 Upgrade Kit

**\$50.00**

#### NOW AVAILABLE

##### XT-88 Turbo Board

A reliable, low cost mother board with IBM PC-XT compatibility, running 1.8 times faster. 8MHz hardware selectable to 4.7 MHz. On-board 8087 socket ready for co-processor chip installation. The 8088-2 processor with 8 I/O slots, 640K RAM and compatible ROM BIOS . . . .

**\$299**

No RAM . . . . . **\$199**

##### AT-286 Mother Board

Here's the power you need to get the job done! IBM PC-AT compatibility enables you to run a broad range of programs, both personal and professional. The board comes with a built-in Real-time clock and 80287 socket for future co-processor insertion. The AT-286 with the Intel 80286 microprocessor running at 8MHz with 640K RAM and Phoenix BIOS processes information faster and more efficiently. Build a high-performance computer and boost your productivity.

Mother Board, 8MHz clock rate, 640K RAM, 8 I/O slots, Phoenix ROM BIOS . . . . . **\$995**

No RAM . . . . . **\$895**

VISA and MASTERCARD Accepted — Please Add \$3.00 Shipping

## HOLLISTON COMPUTER

P.O. Box 615, Chepachet, R.I. 02814

**401-568-0522**

IBM PC-XT-AT, PC-DOS are trademarks of International Business Machines Corp., MC DOS is a registered trademark of Micro-Soft Corp., CP/M is a registered trademark of Digital Research Inc.



# PROLOG On The PC

By Gary Entsminger

## Starting Out In PROLOG

*PROLOG, what's in it for you? What's it like to work with? Who's got the best PROLOG package for beginners writing expert systems (or experts writing beginner systems)? Gary has dug up some very interesting information about new implementations of this language.*

The idea of logic programming isn't new — PROLOG (for Programming in LOGic) was first implemented in Marseilles in 1972 — but its popularity had to wait for the Japanese to select it for their Fifth Generation Project language in 1982.

The Fifth Generation envisions computer hardware engineered for logic processing (earlier generations of computers were engineered for arithmetic processing) and a logic programming language (i.e. PROLOG) for interacting between the logic processing hardware and the upper level software that implements problem solving strategies.

### PROLOG Briefly

Essentially, a PROLOG program is a set of logical definitions about relations. Instead of specifying the flow of actions to be performed (the "how" of execution) as we do in a procedural language like Pascal or C, we describe "what" is to be executed and leave the specifics of implementation to PROLOG. See Figure 1 (benchmark tests) and the factorial program in The Last Page (this issue) for examples of PROLOG programs.

Eight fundamental syntactic concepts compose the PROLOG notation — numbers, variables, constants, lists, clauses, conjunctions, facts, and rules. A PROLOG program consists of a database of sentences (made up of clauses, etc.) that define relations.

A clause (or predicate) is the fundamental way of specifying a relationship between terms. For simplicity, you might think of a predicate as a

resemblance to a procedure or function in a conventional language like Pascal, with arguments enclosed in parentheses. For example —

```
SUCC(X Y) if
    SUM(X Y1 Y).
```

describes the successor relationship in micro-PROLOG.

For a more detailed introduction to PROLOG, see "Programming in PROLOG" by Clocksin and Mellish (published by Springer-Verlag), which

describes the Edinburgh syntax, "micro-PROLOG: Programming in Logic" by Clark and McCabe, which describes the micro-PROLOG syntax, (published by Prentice-Hall), or D.E. Cortesi's excellent article, "A Tour of PROLOG" (in Dr. Dobb's, March '85).

### PROLOG On The PC

Currently, a number of PROLOG interpreters and compilers are available for the PC, ranging in price from a public domain interpreter from Ada

Figure 1a - Turbo PROLOG Program For Reversing A List Using Append

```
domains
    integerlist = integer*

predicates
    reverse(integerlist,integerlist)
    append(integerlist,
        integerlist,integerlist)
    generate(integerlist,integerlist)

clauses

reverse([],[]).
reverse([X|Y],Z):-
    reverse(Y,Y1), append(Y1,[X],Z).
append([],X,X).
append([X|Y],Z,[X|W]):-
    append(Y,Z,W).
generate(0,[]).
generate(N,[N|Y]):-
    M is N-1,
    generate(M,Y).

test:-
    generate(50,X),
    write(X),
    reverse(X,Y),
    write(Y).
```

Figure 1b - micro-PROLOG Program For Reversing A List w/o Tail-recursion

```
(( ) D-reverse (_X _X))
(( _x|_y) D-reverse (_Y _Z) if
    _y D-reverse (_Y (_x|_Z)))
(_X reverse _Y if
    _X D-reverse (_Y ( )))
```



**NOW AVAILABLE for**  
**MS-DOS PC-DOS CPM-86 CCPM-86 CPM-80**  
**SPEED — POWER — VERSATILITY**

# **EXPRESS 2.0**

## **FULL SCREEN EDITOR**

**HIGH PERFORMANCE AT A FAIR PRICE**

**ONLY \$29.<sup>95</sup> 8 Bit Versions | \$34.<sup>95</sup> 16 Bit Versions**

(also available on Micro C MS-Disk #19) to the very expensive PROLOG2 compiler from Expert Systems.

In this review, I'll quickly outline the features of each of the PROLOG tools I tested and indicate which ones will (I believe) serve the beginner and the applications programmer.

In general, PROLOG tools have improved significantly during the past year, and all those tested have merit. The principal differences in the implementations are in syntax, features, speed, documentation, and ease of use. As usual, you get what you pay for, but "higher price" doesn't necessarily mean "better product." Read on.

### **Ada PROLOG**

Ada comes in several flavors, from a beginner's public domain version (mentioned earlier) through an educational and virtual memory version to a full-featured professional implementation. The main differences between them are price and features.

For \$8 you get an Edinburgh core PROLOG without floating point, a debugging (or tracing) facility, random access to files, access to DOS commands, virtual memory, etc. But, if you're just wanting a very inexpensive taste of PROLOG, this might be the place to start. Unfortunately, the lack of so many crucial features (particularly the debugger) will probably give you a distorted view of PROLOG. If I wanted to spend as little as possible to discover what PROLOG is about, I'd spend a little more and get the .FS version.

At \$49.95, .FS PROLOG includes all the features I mentioned in the last paragraph except for virtual memory. The syntax is the Edinburgh standard, so a combination of .FS and a copy of Clocksin and Mellish will be sufficient to get you started toward sophisticated PROLOG programming.

(continued next page)

### **DOES YOUR TEXT EDITOR REMIND YOU OF A 1949 PACKARD...**

Stop abusing yourself. It's time to retire that doggy old clunker!  
**YOU DESERVE EXPRESS 2.0, the 280-Z of the editor world!**

#### **EXPRESS 2.0 FEATURES**

- **FULL ACCESS TO CP/M USERS AREAS** (up to 32) with any editor command!
- **NAMED DIRECTORIES** supported on **MSDOS VERSION!**
- **MEMORY MAPPED VIDEO** AVAILABLE FOR **IBM PC** and **PC clones!**
- **BUILT-IN CP/M LIKE COMMANDS** (RENAME, COPY, ERASE, TYPE, DIR, LOG)!
- **POWERFUL KEYBOARD MACRO'S** (as many as you want)!
- **FULLY RECONFIGURABLE COMMAND KEYS** (emulate any other editor if you like)!
- **FAST, FAST, FAST SEARCH!**
- **TERMINAL DATA BASE..INSTANTLY** configure for **over 50 predefined terminals!**
- **FILES LARGER THAN MEMORY** handled with ease!
- **CONTROL and HIGH BIT CHARACTERS** maybe entered and edited!
- **DYNAMIC WORD WRAP/UNWRAP • FULL CURSOR CONTROL** (and then some)
- **EASY ot SET TAB STOPS • GLOBAL/SELECTIVE/LITERAL/IGNORE CASE REPLACE**
- **FULL BLOCK INSTRUCTIONS** including **PRINT, SAVE, INCLUDE, MOVE, COPY, DELETE**
- **VARIABLE SPEED (FAST!) BI—DIRECTIONAL AUTO SCROLL • GOTO PAGE N / LINE N**
- **COMPACT** on disk and in RAM. (even the 16 bit versions are only 25k bytes)!
- **NOT COPY PROTECTED!**
- **AFFORDABLE..**High performance at a fair price is our motto
- **EXPRESS 1.0 SAMPLER** available **FREE** on your Local Bulletin Board or for only \$10.00 from us. EXPRESS 1.0 is not just a demo. It is a real working editor with enough of the EXPRESS 2.0 features to demonstrate the **POWER** of EXPRESS.

#### **Notes:**

CP/M-80 version requires a Z-80 CPU running CP/M 2.2 or greater.

MSDOS version requires MSDOS/PCDOS 2.0 or higher.

We can support too many 5 inch disk formats to list them all. If you can't use one of the listed formats, please try to give us several options.

Please allow 4-6 weeks for delivery.

Gentlemen...I'm ready to step up to EXPRESS...please send the following:

- \_\_\_\_\_ copies of **EXPRESS 2.0** for CP/M-80 at \$29.95 + \$5.00 shipping and handling  
 \_\_\_\_\_ copies of **EXPRESS 2.0** for CP/M-86 at \$34.95 + \$5.00 shipping and handling  
 \_\_\_\_\_ copies of **EXPRESS 2.0** for MS/PCDOS at \$34.95 + \$5.00 shipping and handling  
 \_\_\_\_\_ copies of **EXPRESS 1.0** for \_\_\_\_\_ CP/M-80 \_\_\_\_\_ CP/M-86 \_\_\_\_\_ MSDOS/PCDOS  
 at \$10.00 + \$2.00 shipping and handling

COD - add \$3.50

Wash. Residents add 7.8% state sales tax

Make check or money order  
 payable to:

Shipping information:

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

Phone Day \_\_\_\_\_ Night \_\_\_\_\_

Disk format desired:

- |                       |      |                         |      |                  |      |
|-----------------------|------|-------------------------|------|------------------|------|
| _____ Kaypro 2        | SSDD | _____ Morrow MD2        | SSDD | _____ 5" Xerox   | SSSD |
| _____ Kaypro 2X/IV/10 | DSDD | _____ Morrow MD3        | DSDD | _____ 5" Xerox   | SSDD |
| _____ Osborne 1       | SSDD | _____ 5" MS/PCDOS STD   | SSDD | _____ 5" Xerox   | DSDD |
| _____ Osborne 1       | SSSD | _____ 5" MS/PCDOS STD   | DSDD | _____ Zenith Z90 | SSDD |
| _____ Epson QX-10     | DSDD | _____ 5" IBM CPM-86 STD | SSDD | _____ 8" SSSD    |      |
| _____ Other           |      |                         |      |                  |      |

# **TOMORROW'S COMPUTING INNOVATIONS**



Table 1 - Benchmarks

| PROLOG    | Factorial Limit | Recursion Limit | Reverse List (50 members) | Reverse(Tail) (300 members) | Search (1000 members) |
|-----------|-----------------|-----------------|---------------------------|-----------------------------|-----------------------|
| ADA(VMA)  | 12!             | 75              | 0:25                      | 16:20                       | 0:36                  |
| ARITY     | 69!             | 300+            | 0:04                      | 0:06                        | 0:08                  |
| Turbo PRO | 171!            | 290             | 0:01                      | 0:02                        | 0:01                  |
| microPRO  | 84!             | 50              | 0:05                      | 0:06                        | 0:06                  |
| MPROLOG   | 10!             | 50              | 0:08                      | 0:06                        | 0:08                  |
| PROLOG2   | 10!             | 50              | 0:04                      | 0:04                        | 0:06                  |

NOTES: All benchmarks use recursion. The recursion limit was determined by the reverse list test which is heavily stack intensive. Reverse(Tail) uses tail recursion and virtually eliminates the use of the stack. Search is a fundamental speed test: searching a 1 rule database. For comparison -- the factorial limit of Turbo Pascal using integers is 71; 33! using reals. All benchmark results shown were executed with interpreters (except Turbo PROLOG). Times for Arity's and Expert's (PROLOG2) compilers are several times faster.

## PROLOG On The PC

(continued from page 7)

The top of the line model from Ada (VMA PROLOG) at \$250 is almost full-featured — including virtual memory, tree structured domains, and access to DOS commands, which allows you to invoke your own choice of editor. Its main drawback is a lack of speed. As the benchmarks show (see Table 1), VMA is the slowest of the PROLOGs tested. So if you're going to spend more than \$50, you might look elsewhere for a PROLOG.

### micro-PROLOG Professional

micro-PROLOG from Programming Logic Systems is the oddball in the PROLOG world syntactically speaking. It implements a LISP-like syntax which differs from Edinburgh's in several ways, in particular in its exclusive use of parentheses in list processing.

For example, in the Edinburgh syntax an expression containing a member and a list might look like this —

```
member(X,[X|_]).
member(X,[_|Y]) :- member(X,Y).
```

The brackets indicate a list. Loosely translated the expression means —

X is a member of a list that has X as its head, and X is a member of a list

that has Y as its tail, if X is a member of the tail of the list.

In micro-PROLOG, we'd write —

```
X member (X|Z)
X member (Y|Z) if X member Z
```

Notice the lack of brackets, the "if" instead of ":-", and the lack of punctuation. You might think of micro-PROLOG as a bare bones PROLOG, perhaps a little harder to read initially, but in the long run, quite powerful.

micro-PROLOG Professional is Programming Logic Systems' top of the line model. It's full-featured, including a WordStar-like editor, screen cursor control, modules, and the capability for interfacing to assembly language subroutines.

It comes with a copy of Clark and McCabe's definitive text (a good tutorial) and the SIMPLE front-end which is very user friendly.

SIMPLE is a windowed environment running above the interpreter which enables you to load files, trace and run programs, add and delete clauses, and edit files.

Once you've gotten the hang of PROLOG, you can bypass SIMPLE and its menus and interact with the interpreter directly, or if you choose you can write your own interactive

front-end (say, for an expert system). The possibilities are limited only by your imagination. APES, an expert system shell from Programming Logic Systems, is an example of such a shell.

micro-PROLOG seems to have few problems — lack of a compiler to create stand-alone programs and the oddball syntax are the main ones. Its documentation is excellent, and its speed in the benchmarks was more than adequate.

It's \$395, and for the money you get an excellent implementation — worthy of beginner or professional.

### PROLOG 1 And 2

Expert Systems offers two choices of PROLOGs — an interpreter (PROLOG1) and a compiler/interpreter combination (PROLOG2). The compiler increases operating speed significantly (about 5 times), but does not compile to standalone programs. At \$1895, the compiler is out of reach for all but the professional developer.

PROLOG1, Expert's interpreter, is a good implementation of the Edinburgh syntax, including numerous built-in predicates for screen and window handling and manipulating the database via hash tables. At \$395 it's competitive with other PROLOGs, although



Table 2 - Features of PROLOG Implementations

| PROLOG    | VER | COST               | MEM  | ED | FLT | DOS | CUR | FILE | WIN | STR | MOD | INT |
|-----------|-----|--------------------|------|----|-----|-----|-----|------|-----|-----|-----|-----|
| ADA(VMA)  | 1.9 | \$200i             | 128K | a  | y   | y   | y   | y    | n   | y   | y   | n   |
| ARITY     | 4.0 | \$350i<br>\$795ic  | 640K | a  | y   | y   | y   | y    | n   | y   | y   | y   |
| Turbo PRO | 0.5 | \$99c              | 384K | y  | y   | y   | y   | y    | y   | y   | y   | y   |
| microPRO  | 1.2 | \$395i             | 256K | y  | y   | n   | y   | y    | y   | y   | y   | y   |
| MPROLOG   | 2.1 | \$495i             | 512K | l  | n   | n   | n   | y    | n   | y   | y   | y   |
| PROLOG2   | 1.2 | \$395i<br>\$1895ic | 384K | y  | y   | y   | y   | y    | y   | y   | y   | y   |

NOTES:

|                             |  |   |   |
|-----------------------------|--|---|---|
| i = interpreter             | ED --  | FLT = floating point  | WIN = predicates for using windows                        |
| c = compiler                | a = accesses your editor from the PROLOG interpreter | DOS = access to DOS from within the interpreter (or compiler) | STR = predicates for string handling                      |
| ic = interpreter & compiler | l = line editor                                      | CUR = predicates for cursor control                           | MOD = modules   |
|                             | y = full screen editor                               | FILE = random access to files                                 | INT = interface to other languages (assembler, C, Pascal) |

lacking the excellent windowed, user-friendly environment (complete with online help) that comes with PROLOG2.

Like micro-PROLOG, PROLOG2 creates a work space conducive to learning PROLOG, but unfortunately, the documentation, while technically complete (running to about 500 pages) wouldn't give the beginner much comfort (if he could afford it), confirming my impression that PROLOG2 is not intended for the first time PROLOG programmer. However, PROLOG1 (the interpreter) does come with a tutorial.

Both systems are powerful, performing very well on the speed benchmarks (although the arithmetic is limited).

### MPROLOG

MPROLOG is a mainframe PROLOG translated to the PC, reasonably fast, although (like PROLOG2) limited for arithmetic. Oddly, it lacks floating point and includes a line instead of full screen editor — a weak combination.

The editor is easy to use once you get the hang of it, but a lot of keystrokes are necessary in order to modify a clause in a module.

For example, given this module —  
MODULE Test.

All\_global.

body.

test:-

write(X).

In order to change "write(X)" to "write(Y)", you would have to focus the module and rule by entering —

f M test

then list the rule test —

list test

to determine the line number. And then enter the editor with —

edit

Then make the change like so —

10: write(Y)  
end

and return to command mode. It's not a difficult process, but it is tedious.

MPROLOG's documentation is lengthy (running to 500 or so pages) and useful, but like its editor, cumbersome to use. I'd have traded most of those pages for a few concise, easy-to-locate lists of commands.

Although MPROLOG appears to be an advanced system in some ways (modules, trace facilities, assembler interface, loads of built-in predicates), it does not beckon to the beginner and lacks important features for the professional — floating point, full screen editor, cursor control, windows, and access to DOS commands.

### Arity

Arity PROLOG, like Ada PROLOG, comes in a variety of flavors — an Edinburgh core interpreter (for \$95) which implements the Clocksin and Mellish syntax, a full-featured interpreter (for \$350), and an interpreter and compiler (for \$795).

The core interpreter comes with a copy of "Programming in PROLOG" by Clocksin and Mellish and is a good starting point for the beginner. If you decide later to get serious about PROLOG, you can move up to one of their professional versions.

(continued next page)



(continued from page 9)

Arity's full-featured interpreter has mostly right ideas about a programming environment. Although an editor isn't included you can access your favorite from within PROLOG. The transfer is clean and quick.

Arity's professional versions include numerous built-in predicates for handling strings and files, accessing ports, and manipulating the database. No fewer than 10 predicates allow you to access the database via indices, hash tables, and b-trees, significantly reducing search times.

Arity PROLOG is definitely a professional implementation limited primarily by a lack of screen handling predicates and a windowed programming environment. It's fast, reliable, and the combination of interpreter and compiler allows the programmer to build standalone applications without the additional expense of licensing fees.

#### Turbo PROLOG

Borland's approach is a dramatic departure from traditional thinking. They've chosen a compiled rather than an interpretive implementation (allowing the development of standalone programs), and they're using strict type checking.

Strictly speaking, type checking seems to oppose the freeform spirit of PROLOG in which data and rules are often entwined in a knowledge base jungle.

But type checking, as any once-bitten C programmer knows, has its merits despite the objections of PROLOG purists (I leave the philosophical discussion as an exercise to you-know-who). In particular, in PROLOG, it adds speed to program execution.

A decrease in the bookkeeping (which is required of other compiled PROLOGs) enables Turbo PROLOG to blast through data and rules in mind boggling numbers of logical inferences per second (or LIPS to the initiated). Turbo PROLOG is much faster than the other PROLOGs I tested.

In addition, its programming environment is exceptionally user friendly, with Reflex-like multi-windows and menus and an array of other features (see Table 2).

One of the strengths of a PROLOG program is its flexibility, permitting the user to modify the program at runtime (wow!). The interpretive PROLOGs append and retract data to and from the program via (of course) the interpreter. Compiled versions like Arity PROLOG include key features of the interpreter in the standalone programs.

Borland's solution again is novel. Turbo PROLOG allows you to call the editor from a running (compiled) program and modify marked areas (databases). Type checking is again a key to the implementation.

Apart from the controversial type checking issue, the only potential limitation I see for TP is its lack of a virtual memory facility, a feature of all other major PROLOGs.

Turbo PROLOG requires 384K of RAM, and although many PCs have been upgraded to 640K, the professional applications programmer might be frustrated by so little room for data (gee whiz, we used to be thrilled by the seemingly boundless space of 64K). However, databases can be expanded to disk which more or less circumvents the virtual memory problem.

The documentation is very good (perhaps excellent) and includes numerous programming examples, making it an accessible (and enjoyable) starting point for the first time PROLOG programmer and the just curious.

Although the version I tested was an early beta-test version (0.5) and suffered from a few minor bugs, Turbo PROLOG looks like it's going to be a winner, for both the beginner and professional programmer.

#### Wrap It Up

As usual, I don't think any review can completely express the desirability or undesirability of a product. Tastes differ. Your piques differ from mine.

In this case, each PROLOG implementation has merit, and I can't say definitively that any one is THE one.

If you're only a little curious about PROLOG, then save your nickels, dimes, quarters, and dollars, and peek into the public domain or maybe the ADA .FS version.

If you think you might be serious, but hate to spend a penny more than

necessary, than Turbo PROLOG (or Arity's low-end model) is the way to fly.

And if you know already that PROLOG indeed signals the beginning of the Fifth Generation, and you intend to write a professional expert system, produce prototypes, construct natural language interfaces, prove theorems, and who knows what else, pick in order of what you can afford — one of the heavyweights (Arity or PROLOG2), micro-PROLOG (odd but very good), or TP (the new kid in town from Borland).

In any event, if you don't check into this fascinating newfangled language, you're missing out.

Cheers.

For more info —

Arity PROLOG:  
Arity Corp.  
336 Baker Ave  
Concord MA 07142  
617-371-1243

Ada PROLOG:  
Automata Design Assoc.  
1570 Arran Way  
Dresher PA 19025  
215-646-4894

Turbo PROLOG:  
Borland International  
4585 Scotts Valley Dr  
Scotts Valley CA 95066  
408-438-8400

PROLOG1 & 2:  
Expert Systems International  
1150 First Ave  
King of Prussia PA 19406  
215-337-2300

micro-PROLOG:  
Programming Logic Systems  
31 Crescent Dr  
Milford CT 06460  
203-877-7988

MPROLOG:  
Logicware  
5000 Birch St, W Tower St  
Newport Beach CA 92660  
714-476-3634





# EPIC SALES, INC.

## — FIXED DISK DRIVE SYSTEMS

|                        | 10 MEG | 20 MEG | 30 MEG |
|------------------------|--------|--------|--------|
| TI PC (Zobex)          | \$699  | \$ 749 | \$ 899 |
| TI PC (Western Auto.)  | 999    | 1049   | 1199   |
| TI PC (SASI)           | 599    | 649    | 799    |
| TI Bus. Pro.           | 749    | 799    | 949    |
| IBM PC and Compatible* | 549    | 599    | 749    |
| Sanyo 550/555          | N/A    | 799    | 949    |
| Zenith Z-100           | N/A    | 899    | N/A    |

For External Units Add \$200

Above include drive, controller, cables, one year warranty and 30 day return privilege. Call for pricing on larger size drives.

\*Compatibles: AT&T, Compaq, Tandy, Columbia, Corona, Zenith, Others.

## — TAPE BACKUP SYSTEMS

|                                |        |
|--------------------------------|--------|
| Irwin Internal 10 Meg          | \$ 595 |
| Irwin Internal 20 Meg (for AT) | 695    |
| Wangtek Internal 60 Meg        | 1049   |
| For External Units Add \$100   |        |

## — AT&T PERSONAL COMPUTER

|  |        |
|--|--------|
| 6300, Mono, 640K, 2 Floppy, DOS, Basic         | \$1995 |
| 6300, Mono, 640K, 1 Floppy, 20 Meg, DOS, Basic | 2395   |
| 6300 Plus, Mono, 640K, 2 Floppy, DOS, Basic    | 4295   |
| For High Resolution Color Add                  | 459    |

## — OLIVETTI PERSONAL COMPUTER

(Same as AT&T 6300)

|  |        |
|--|--------|
| Mono, 640K, 2 Floppy, DOS, Basic         | \$1895 |
| Mono, 640K, 1 Floppy, 20 Meg, DOS, Basic | 2295   |
| For High Resolution Color Add            | 459    |

## — IDS PERSONAL COMPUTER

|   |        |
|---|--------|
| Mono, 256K, 2 Floppy, P-Port, DOS         | \$1195 |
| Mono, 640K, 2 Floppy, 20 Meg, P-Port, DOS | 1795   |

## — FIXED DISK DRIVES FOR IBM AT AND TI BUSINESS PRO

|   |        |
|---|--------|
| 20 Meg Seagate ST-225 (65 ms)                   | \$ 439 |
| 20 Meg Seagate ST-4026 (40 ms)                  | 739    |
| 30 Meg Seagate ST-238 (65 ms)                   | 589    |
| 30 Meg Seagate ST-4038 (40 ms)                  | 959    |
| 33 Meg Rodime RO-203E (55 ms)                   | 929    |
| 51 Meg Seagate ST-4051 (40 ms) (Bus. Pro. only) | 1149   |
| 72 Meg CDC Wren (35 ms)                         | 1949   |
| 119 Meg Maxtor 1140 (30 ms)                     | 4595   |

## — OKIDATA PRINTERS

|   |        |
|---|--------|
| Model 182-IBM, 120 CPS, 9 in. Carriage  | \$ 259 |
| Model 192-IBM, 160 CPS, 9 in. Carriage  | 439    |
| Model 193-IBM, 160 CPS, 15 in. Carriage | 609    |

## — FLOPPY DISK DRIVES

|   |     |
|---|-----|
| Epson SD-521 DSDD 5.25 in. Floppy Drive   | 119 |
| Shugart SA-465 DSDD 5.25 in. Floppy Drive | 159 |
| Siemens FD 200 8 in. DSDD Floppy Drive    | 185 |

## — EXPANSION CARDS

|   |        |
|---|--------|
| STB Super RIO Plus II Multifunction Card (64K)  | \$ 259 |
| STB Graphics II Plus Card                       | 305    |
| STB Chauffeur Mono Graphics Card                | 259    |
| STB Super I/O Plus Card                         | 195    |
| STB Serial Card                                 | 95     |
| STB Parallel Card                               | 79     |
| Zobex ZX2T Controller CARD for TIPC             | 335    |
| Western Digital WX2S Controller Card for IBM PC | 169    |
| Taxan Model 555 Color Graphics Card             | 229    |
| Central Point Copy II PC Option Board           | 89     |
| Microsync dClock Real Time Clock                | 59     |
| Western Automation S1 Multifunction Card (OK)   | 355    |
| Western Automation S3 Multifunction Card (OK)   | 545    |
| Western Automation Clock Option                 | 125    |
| 512 K Ram Expansion Card for TI PC              | 259    |
| 128K Ram Expansion Card for TI Bus. Pro.        | 169    |
| Epic 1 Meg Ram Expansion Card for TI Bus. Pro.  | 995    |
| Epic 2 Meg Ram Expansion Card for TI Bus. Pro.  | 1595   |
| Epic 3 Meg Ram Expansion Card for TI Bus. Pro.  | 2195   |

## — MODEMS

|                                       |     |
|---------------------------------------|-----|
| Hayes 1200B Internal (IBM or TI)      | 399 |
| Prentice Pop Com External (IBM or TI) | 339 |

## — PC REPLACEMENT POWER SUPPLY

|                      |     |
|----------------------|-----|
| 150 Watt Side Switch | 109 |
|----------------------|-----|

## — INTEL MATH COPROCESSOR IC

|               |        |
|---------------|--------|
| 8087-3 (5 MZ) | \$ 150 |
| 8087-2 (8 MZ) | 175    |

## — RAM CHIPS

|               |      |
|---------------|------|
| 4164 (150ns)  | 1.30 |
| 41256 (150ns) | 4.00 |

## — NEC REPLACEMENT PROCESSOR

|                              |       |
|------------------------------|-------|
| V-20 (5 MZ 8088 REPLACEMENT) | \$ 20 |
| V-30 (8 MZ 8086 REPLACEMENT) | 35    |

## — TAXAN COLOR MONITORS

|   |     |
|---|-----|
| Taxan Model 630 High Resolution Monitor | 539 |
| Taxan Model 640 High Resolution Monitor | 639 |

## — OTHER PRODUCTS

|  |       |
|--|-------|
| World Media 5.25 in. DSDD Floppy Diskette        | \$ 10 |
| Disk File 120, 5.25 in. Disk Storage             | 9     |
| A-B Switch Box                                   | 55    |
| Keytronic KB5151 Keyboard                        | 199   |
| Cabinet and Power Supply for (2) 5.25 in. Drives | 72    |

## EPIC SALES INC.

132 WALNUT PLANO CENTER  
GARLAND, TX 75042

TOLL FREE ORDER LINE: 1-800-223-EPIC  
TECHNICAL INFO AND INQUIRIES: 1-214-272-5724

TERMS: CASH, CHECK, COD, MASTERCARD AND VISA ADD 3%.  
AMERICAN EXPRESS ADD 5%. TEXAS RESIDENTS ADD 6.125% SALES TAX.



# Expert Systems And Logic Programming

By Ramachandran Bharath

Mgmt, Mktg, & C.I.S. Dept.  
Northern Michigan University  
Marquette MI 49855

*What is an expert system? How is it created? Why are list processing languages like PROLOG associated with expert systems rather than more familiar procedural languages like Pascal? Here are some answers.*

An expert system is a program which can function as a consultant or advisor with a level of skill and reliability comparable to that of a human expert.

Although expert systems currently replicate the skills of human experts, future systems may be developed in areas of problem solving where there are no human experts.

The aim of this article is to outline the characteristics of an expert system and discuss why logic or list processing languages are more convenient for implementing expert systems than procedural languages like C, Pascal, or FORTRAN.

In particular, we'll examine the programming language PROLOG, Japan's choice of a starting point for "Fifth Generation" or "Knowledge Information Processing Systems."

## General Principles

The important facets of an expert system are —

1. Knowledge Base
2. Inference Engine
3. Explanation Subsystem
4. Natural Language Interface
5. Knowledge Acquisition And Refinement Subsystem

## Knowledge Base

The Knowledge Base includes the components of the program which contain relevant knowledge for a field of expertise. It contains suitable representations of facts and heuristic rules (uncertain rules which can be relied on most, but not all, of the time).

In other words, the knowledge base

includes the informal and highly reliable (but not absolutely certain) knowledge which experts work with and the formal principles which compose the knowledge in any field.

## Inference Engine

The Inference Engine uses the facts and rules in the knowledge base in conjunction with the particular circumstances of a specific situation to draw conclusions (or inferences) and give advice.

## Explanation Subsystem

The Explanation Subsystem, at a user's request, explains the underlying facts and rules the expert system used to draw its conclusions. Part of this subsystem is a facility for explaining why the system asks for additional information.

## Natural Language Interface

The Natural Language Interface enables the user to interact with the system in a language as close to English (or French, or German, etc.) as possible.

## Knowledge Acquisition And Refinement

The Knowledge Acquisition and Refinement Subsystem allows additions to and revisions of the knowledge and rules in the knowledge base.

See Figure 1, a schematic diagram of an expert system.

## Expert Or Conventional

An expert system differs primarily from a conventional program by emphasizing the knowledge base.

In the 1950s and 1960s, the search for ways of making computers into more powerful problem-solvers focused on discovering GENERAL problem solving techniques. While this approach did yield some results, for example in mathematical theorem proofs, it wasn't very successful.

Eventually, there was a shift to an approach best summarized by Dr. Feigenbaum, the designer of the DENDRAL expert system for spectrographic analysis of chemical structure (generally regarded as the first expert system).

"In the knowledge is the power," he said. Or in other words, the effectiveness of an expert depends not only on his native intelligence but also on the vast stores of knowledge he acquires in a specific field. No all-purpose technique will work in all fields.

This approach led to some useful expert systems — DENDRAL; meta-DENDRAL; MYCIN, a program for diagnosis of bacterial infections; PROSPECTOR, a program for geological forecasting; and so on. For more details on these programs see references 1 and 2.

## If — Then

Marvin Minsky of MIT, a pioneer and leader in Artificial Intelligence, has written: "In a sense, today's expert systems demonstrate a marvelous fact we did not know 25 years ago: if you write down if-then rules for a lot of situations and put them together well, the resulting system can solve problems that people think are hard."

In that sense, a conventional program makes use of "knowledge" too, for any if-then statement in any language is the application of knowledge to draw a conclusion. But the distinctive feature of an expert system is that the knowledge base can be modified and the inference engine (an interpreter) can apply information from the knowledge base to the current situation.

The separation of knowledge base and inference mechanism could be achieved in a conventional language, but it's far easier to implement in languages like LISP and PROLOG.

The key feature of these two languages is the lack of a clear distinction



Figure 1 - Block Diagram For Expert System

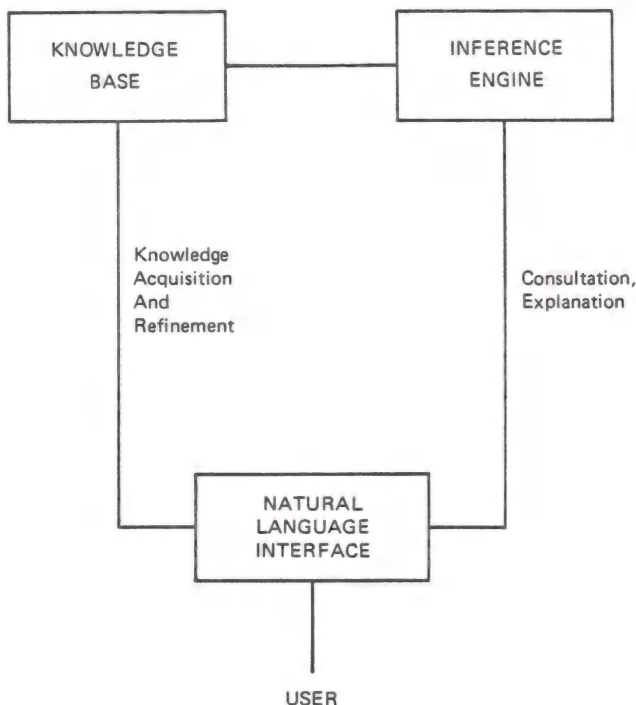


Figure 2 - Knowledge Base

```

elections(Country) :-
economy(Country, Condition),
Condition = booming,
incumbent(Person, Country),
write(' 0.6 chance of win for '),
nl,
write(Person),
nl,
!.
elections(Country) :-
challenger(Person, Country),
write('challenger '),
write(Person),
nl,
write('likely to win'),
nl,
!.
economy(usa,booming).
incumbent(reagan,usa).
challenger(mondale,usa).
    
```

between "data" and "program." The knowledge base is both program and data, so the user can modify not only data but the program itself at runtime. In other words, programs modify themselves as they acquire more information, a key aspect of powerful problem solving.

### Knowledge Engineering

The big problem in developing an expert system is extracting and refining the set of rules and facts from a human expert.

This task, known as "knowledge engineering," has obvious problems. For example, an expert may not be aware of all the rules and knowledge he or she uses to solve a problem.

So the knowledge engineer may have to do a great deal of sleuthing as he builds the knowledge base. And, of course, the more complex the field, the more difficult the task.

Let's consider a simple PROLOG program or "knowledge base" which makes predictions about election results using a simple rule — if the

economy is booming, predict a win for the incumbent, with a probability of 0.6. If the economy isn't booming, predict a win for the challenger.

If we put in all the information about the incumbent and the challenger, the rules (discussed above) for drawing conclusions, and express it in standard PROLOG syntax, we'd have the knowledge base shown in the listing in Figure 2.

Let's review the basic principles of PROLOG to see how this works.

A PROLOG program consists of facts and rules.

FACTS express relationships between objects. For example, the fact — `incumbent(reagan,usa)`. — relates the two objects "reagan" and "usa".

One standard PROLOG convention (the Edinburgh syntax) expresses constants in lower case and variables with an upper case letter as the first letter.

PROLOG works by matching the questions entered by the user to facts in the database. So, if a user enters —

?-incumbent(Who,usa).

PROLOG will match the variable "Who" to the constant "reagan" and output —

Who = reagan.

Similarly, the question —

?- challenger(mondale, Where).

would generate the response —

Where = usa.

based on the principles of pattern matching. The fact, Where, is a variable and can be matched with "usa". This kind of pattern matching is usually referred to as "satisfying a goal."

In the above examples, we set the goals —

?- incumbent(Who,usa), and ?-challenger(mondale,Where).

and PROLOG met them.

(continued next page)



(continued from page 13)

**PROLOG Power**

PROLOG gets its power from rules.

For example, in one of the RULES in Figure 2 we have the segment shown in Figure 3.

If we enter the goal —

?- elections(usa).

the system will match "elections" with the left of the :- sign, and then continue to match each of the goals on the right of the :- sign in turn.

Think of the ":-" as signifying "if", so in general a rule states that the goal on the left of ":-" (the HEAD OF THE RULE) can be satisfied IF the goals on the right of the ":-" (the BODY OF THE RULE) can be satisfied.

So to satisfy —

?-elections(usa).

the system first matches our question with the HEAD, elections(Country), and identifies the variable "Country" as "usa". Next, it proceeds to the BODY of the rule and tries to satisfy the goals one by one.

The first goal is economy(usa, Condition), and it can be matched with the fact, economy(usa,booming). The variable "Condition" is matched with "booming".

The next goal is Condition = booming, and it's now true.

Next, the system tries the goal "incumbent(Person,usa)" and identifies the variable "Person" with "reagan". Then it goes on to examine the other goals. The goals with "write" are self-explanatory, and "nl" stands for "print a new line".

To conclude this very condensed review of PROLOG, let's suppose that instead of —

economy(usa,booming).

we had —

economy(usa,shaky).

in our knowledge base. The system would be unable to "satisfy" the goal "economy(usa,booming)".

Figure 3 - Excerpt From Figure 2

```
elections(Country) :-
economy(Country, Condition),
Condition = booming,
incumbent(Person, Country),
write(' 0.6 chance of win for '),
nl,
write(Person),
nl,
!.
```

Figure 4 - Addition To Figure 2

```
(after deleting
incumbent(reagan,usa),
challenger(mondale,usa), and
economy(usa,booming) ).

challenger(Name, Country) :-
write('Who is the challenger?'),
nl,
read(Name),
asserta(challenger(Name, Country)).

incumbent(Name, Country) :-
write('Who is the incumbent?'),
nl,
read(Name),
asserta(incumbent(Name, Country)).

economy(Country, Condition) :-
write('Is current state of economy '),
write('booming?(y or n)'),
nl,
read(y),
asserta( (economy(Country, booming) :- !) ).
economy(Country, Condition) :-
asserta( (economy(Country, shaky) :- !) ),
fail.
```

Figure 5 - Rule For Using Expert System

```
economy(Country, Condition) :-
write('Is current state of economy '),
write('booming?(y or n)'),
nl,
read(y),
asserta( (economy(Country, booming) :- !) ).
```



When a goal fails, the system reverses its tracks and tries to find an alternative solution for the next goal on the left. This very important aspect of PROLOG is called BACKTRACKING.

In our example, PROLOG will go down the knowledge base trying the second rule with the same head "elections(Country)". Eventually, it will print the message "challenger mondale is likely to win".

### Learning

We can jazz up the above program to make it a more helpful learning program.

(Note: the cut operator (!) is, roughly speaking, a way of telling PROLOG not to look for alternative solutions.)

Suppose we don't want to specify who the challenger is, who the incumbent is, and what the state of the economy of the usa is, as we did earlier. Instead we want the program to get this information by prompting the user.

We can arrange this new structure by deleting the facts about challenger, incumbent, and condition of the economy currently in the knowledge base and adding the new information in the listing shown in Figure 4.

Suppose we again ask —

?elections(usa).

After the same train of analysis, we see that the system will try to satisfy the goal —

?economy(usa,Condition).

first, but finding no fact to match will use the rule shown in Figure 5.

The goal, read(y), is satisfied if the user types "y" to confirm the economy is booming, and the system proceeds further.

Now the goal "asserta" tells the system to add the fact "economy(usa,booming)" to the knowledge base as a newly learned bit of knowledge, and the next time we ask a question about "elections(usa)", the system won't ask for information, but will match the goal "economy(usa,Condition)" with the new (added) fact.

Similarly, by analyzing the elections

rule, we can see that the first time we ask the question, the system will ask for the name of the incumbent and add this to the database.

Having satisfied all the goals, it will print the message —

0.6 chance of win for reagan

as before. But now, if we ask —

?elections(usa).

it will proceed directly to the message, having "learned" the condition of the economy and the name of the incumbent.

And just as we can "assert" to add information to the database, we can "retract" to remove it.

Suppose we enter —

?retract(( economy(usa,booming) :- ! )).

and then ask —

?elections(usa).

The system will then ask about the condition of the economy, and if we now say "n" to indicate the economy is not booming, the system will backtrack, add the information —

economy(usa,shaky):- !

to the knowledge base, and then try the second rule for elections, asking for the challenger's name. That name is added to the database, and the message about the challenger being likely to win is output.

### Wrap Up

I hope this brief introduction to expert systems has whetted your appetite for more information about the possibilities of this fascinating language.

In PROLOG, the emphasis is on describing the structure of the problem, rather than specifying the steps required in searching for a solution. You might think of a conventional language as being "imperative," i.e. giving specific commands to the computer, and PROLOG as being "assertional," i.e. describing or making assertions about the problem, leaving it to the system to work out the specific

## CPM-80 LIVES ON YOUR PC

CP/Mulator puts a 4mhz 8 bit CPM-80 emulator in your IBM-PC for only \$99.

- Execute 8 bit CP/M programs at 4 mhz. Stop waiting around for those slow software emulators at twice the price of this speed demon!
- CP/Mulator makes a fantastic CP/M development environment and allows you to use all your CPM-80 tools, and the IBM-PC tools too!
- Why write off that expensive package that you bought for CPM-80 just because you upgrade to a IBM-PC? Apply the \$99 solution and keep it working. No retraining or conversion blues!
- CP/Mulator includes the NEC uPD70108 processor which increases the speed of your IBM-PC by at least 10%. 100% compatible with existing IBM-PC software and 8087 compatible.

**PURCHASE THE SOFTWARE ALONE FOR ONLY \$69!!**

**Source Information**

**P.O. Box 2974**

**Warminster, PA 18974**

**Phone (215) 628-4719**



steps required for finding a solution.

There are slight differences in the various implementations of PROLOG; my examples have been run successfully with EDPROLOG (from Ada) and PROLOG V (from Solution Systems).

### References:

1. WINSTON, P.H. and PRENDERGAST, K.A. (editors) — The AI Business: The Commercial Uses of Artificial Intelligence (MIT Press, Cambridge, MA 1984).
2. HAYES, J.E. and MICHIE, D. (editors) — Intelligent Systems (John Wiley/Halsted Press, New York, NY 1983). See especially the article "Knowledge Engineering: The Applied Side" by E.A. Feigenbaum.
3. CLARK, K.L. and MCCABE, F.G. — PROLOG: A Language for Implementing Expert Systems, in MACHINE INTELLIGENCE 10 edited by Hayes, J.E., Michie, D., and Pao, Y-H (Halsted Press, New York, NY 1982).





# ERAC CO.

8280 Clairemont Mesa Blvd., Suite 117

San Diego, California 92111

(619) 569-1864 Call for our Test Equipment Mailer!

## KAYPRO EQUIPMENT

|                         |         |
|-------------------------|---------|
| 9" Amber CRT            | \$39.00 |
| 9" Green Monitor        | 35.00   |
| 12" Green Monitor       | 45.00   |
| 81 Series ROM's         | 7.00    |
| Keyboard (Kaypro)       | 75.00   |
| Keyboard Siemens w/case | 65.00   |
| Wiring Harness          | 7.50    |

## KAYPRO MAINBOARDS

|                       |         |
|-----------------------|---------|
| K2 With Sockets       | \$39.00 |
| K2 Populated - Tested | 129.00  |
| K2 with PRO8-3 Mod.   | 239.00  |

*This one runs at 2.4 & 5 MHz, up to 4 drives SS, DS, or Quad drives. New ROM has screen dump and step speed select. With manual & software, tested and guaranteed 30 days.*

|                         |        |
|-------------------------|--------|
| K2 PRO8-3 Mod. EXCHANGE | 149.00 |
|-------------------------|--------|

*We will update your K2 or K4 as above. Mail working Main board.*

We can install double or quad drives and check complete package . . . CALL

|                               |        |
|-------------------------------|--------|
| K10 Populated - Tested        | 250.00 |
| WD1002-5 Hard Disk Controller | 200.00 |
| Host Interface Board          | 15.00  |

## CABINETS

|   |         |
|---|---------|
| K2X   | \$45.00 |
| K10   | 45.00   |
| <i>Bottom portion with front and back only.</i> |         |
| CRT Bezel                                       | 12.00   |

## SUBSTITUTE CABINET

*This cabinet has a 12" green monitor on top that swivels left to right with a 3-position vertical movement. The base is 16"x18"x5" and contains a switching power supply. It has room for the main board, two drives, a modem and whatever else you want to stuff in it. It comes with a Siemens keyboard with case and is programmed like the Kaypro keyboard with many extra Wordstar and CP/M commands. The whole cabinet is color-coordinated and sharp looking. Nobody will ever suspect this is a Kaypro. Now you can build the classiest Kaypro computer ever for less than \$550.00. The complete cabinet is a steal at*

**\$179.00**

## MISC. CABLES

|                                 |        |
|---------------------------------|--------|
| 9" 50 Pin - 50 Pin Header       | \$2.50 |
| 14" 40 Pin - 40 Pin Header      | 2.25   |
| 9" Hard Disk - 20 Pin Header    | 2.00   |
| 14" Dual Inline 16 Pin Male (2) | 2.00   |

## Pioneer LD700 Laser Video

|                         |          |
|-------------------------|----------|
| Disk Player             | \$299.00 |
| Wireless Remote Control | 55.00    |

## ERAC CO.

8280 CLAIREMONT MESA BLVD., SUITE 117  
SAN DIEGO, CA 92111 (619) 569-1864

HOURS: Mon. - Fri. 9 - 6 - Sat. 10 - 4

MINIMUM ORDER - \$15.00

TERMS: VISA, MasterCard, Certified Checks, Money Order, NO COD. Visa and MasterCard add 3%. Personal checks must clear BEFORE we ship. Include shipping charges. California residents add 6% Sales Tax. For more info please call - DON'T WRITE! We don't have time to answer your letters.

## ★ SPECIALS ★

★★★★★★★★★★★★★★★★★★★★  
Bahco Wire Cutter "Swedish" . . . 6.95  
★★★★★★★★★★★★★★★★★★★★

## CPU/SUPPORT

|                        |         |
|------------------------|---------|
| MC68000-8 CPU          | \$12.50 |
| C80186-3               | 27.00   |
| C80186-6               | 9.00    |
| Z80 CPU                | 1.00    |
| Z80A CPU               | 2.50    |
| Z80A PIO               | 2.50    |
| Z80A SIO               | 5.00    |
| Z80A DMA               | 10.00   |
| 8088                   | 10.00   |
| 8089-3                 | 29.00   |
| D8742 CPU/EPROM 12 MHz | 20.00   |
| D8284A                 | 3.00    |
| D8288                  | 9.00    |
| 4164-15                | 1.50    |
| 41256-15               | 3.00    |
| 41256-12               | 3.25    |

## MODEM

|                    |         |
|--------------------|---------|
| TMS 99532 (Modem)  | \$12.00 |
| TMS 99531 (Dialer) | 8.00    |

## FLOPPY CONTROLLER

|         |        |
|---------|--------|
| WD 1791 | \$9.00 |
| WD 1793 | 5.00   |
| WD 1797 | 7.00   |
| WD 2797 | 9.50   |

## BAUD GENERATOR

|         |        |
|---------|--------|
| WD 8116 | \$4.50 |
|---------|--------|

## MISCELLANEOUS

|                      |        |
|----------------------|--------|
| UC3524 Sw. Reg.      | \$ .85 |
| WD1010               | 20.00  |
| WD1014               | 28.00  |
| WD1015               | 28.00  |
| MM58167A Clock Chip  | 5.50   |
| CA301 Op Amp         | .35    |
| CA083 Op Amp         | .45    |
| 2N3055               | .70    |
| 2N6852               | 1.00   |
| Voltage Regulators   |        |
| LM323K + 5V/3A       | 4.50   |
| LM78H12 + 12V/5A     | 5.00   |
| 6116 2Kx8 Static Ram | 1.50   |

## VIDEO CONTROLLER

|         |        |
|---------|--------|
| 6545    | \$7.00 |
| 6545A-1 | 8.00   |
| 6845    | 6.00   |

## EPROMS

|         |        |
|---------|--------|
| 2716    | \$3.50 |
| 2732    | 3.75   |
| 2764    | 2.25   |
| 2764-25 | 3.50   |

## 74LS SERIES

|        |        |
|--------|--------|
| HC00   | \$ .35 |
| HCU04  | .40    |
| LS 125 | .40    |
| LS 373 | .60    |
| LS 375 | .60    |
| 4073   | .35    |
| 7406   | .40    |

## SOLAR CELLS

|                         |        |
|-------------------------|--------|
| 2 1/2" x 5/16", .5V/.5A | \$2.25 |
|-------------------------|--------|

## LOW PROFILE IC SOCKETS

|                                |             |        |
|--------------------------------|-------------|--------|
| 8 Pin                          | 50 per Tube | \$2.50 |
| 14 Pin                         | 25 per Tube | 1.50   |
| 16 Pin                         | 25 per Tube | 2.25   |
| 18 Pin                         | 25 per Tube | 2.50   |
| 20 Pin                         | 20 per Tube | 2.00   |
| 24 Pin                         | 20 per Tube | 2.50   |
| 28 Pin                         | 10 per Tube | 2.00   |
| 40 Pin                         | 10 per Tube | 1.60   |
| 16 Pin Component Carrier, Gold |             | .25    |

## PRINTERS

|                             |          |
|-----------------------------|----------|
| Centronics 703              | \$395.00 |
| Centronics 588 - As Is      | 125.00   |
| NEC2000 w/Single Sheet Feed | 1200.00  |

## \$100

|                         |          |
|-------------------------|----------|
| CCS 2200 12 slot MF     | \$375.00 |
| CCS 2810A CPU           | 210.00   |
| 2065 64K RAM            | 250.00   |
| 2422 FDC 5 1/4" & 8"    | 325.00   |
| 2718 I/O 2 Ser., 2 Par. | 225.00   |

## POWER SUPPLIES

### - WALL PLUG-IN TYPE -

|           |        |
|-----------|--------|
| 6VAC/.95A | \$1.35 |
|-----------|--------|

### - LINEAR -

|                                    |         |
|------------------------------------|---------|
| Condor Model CP731 DC Power Supply |         |
| +14V/4A, +5V/7A, ±15V/.5A          | \$16.00 |
| Power Supply with                  |         |
| Nicad Pack 12V/.5AH                | 6.50    |
| 14KV DC/DC TV Power Supply         | 4.50    |
| +5V/1A, -5V/.2A, +12V/1A,          |         |
| -12V/.2A, -24V/.05A                | 15.00   |
| +24V/2.2A                          | 8.00    |

## SWITCHERS

|                             |         |
|-----------------------------|---------|
| 5V/9.5A, 12V/3.8A, -12V/.8A | \$39.00 |
| 5V/3A, 12V/2A, -12V/.4A     | 29.00   |
| 5V/10A                      | 25.00   |
| 5V/75A, +12V/8A, +12V/8A    | 55.00   |
| 5V/20A                      | 35.00   |

## FLOPPY DISK DRIVES

### - 1/3 HEIGHT -

|   |         |
|---|---------|
| Okidata DSDD                                | \$99.00 |
| <i>Supplied w/sub-panel to make 1/2 ht.</i> |         |

### - 1/2 HEIGHT -

|                             |          |
|-----------------------------|----------|
| Mitsubishi M4851 DSDD 40 Tr | \$139.00 |
| Mitsubishi M4853 DSDD 80 Tr | 139.00   |
| Qume Trak 142 5 1/4" DSDD   | 99.00    |
| Tandon TM 848-1 8" SSDD     | 149.00   |
| Shugart 475 DS Quad         | 159.00   |

### - STANDARD HEIGHT -

|                               |         |
|-------------------------------|---------|
| Shugart SA460 DS Quad - As is | \$36.00 |
| Shugart SA850 8" DSDD         | 199.00  |
| Remex RFD4000                 | 199.00  |
| Persci 277 2x8"               | 399.00  |

## TERMINALS

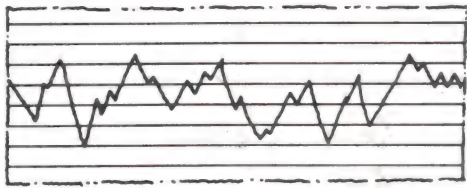
|                              |          |
|------------------------------|----------|
| InterTube II Smart (B&W)     | \$195.00 |
| InteColor 3602 Smart (Color) | 329.00   |

## MISCELLANEOUS

|                              |        |
|------------------------------|--------|
| Headset/Boom Microphone      | \$3.95 |
| Lead Acid D Cell 2V/2.5A     | 1.50   |
| Nicad Pack 12V/.5AH          | 6.50   |
| 5 Blade Muffin Fans          | 7.50   |
| Joystick 4 Switches 1" Knob  | 5.50   |
| Elgar 400W Unint. Power Sup. | 375.00 |
| 10 Ft. Line Cord             | 1.65   |



# VEDIT<sup>®</sup> Plus Text Editor



The Navy charts new concepts with it... GM

engineers the future with



it...



National Can preserves

facts

with it... GE has bright



ideas with it... Here's why you  
shouldn't be without it.

Every day, VEDIT PLUS helps thousands of programmers, writers and engineers get down to business.

So why do people who could have ANY text editor prefer ours? For a lot of reasons, including:

- **CAPACITY**—With VEDIT PLUS, file size is never a problem. And virtual disk buffering simplifies editing of even the largest files.
- **FLEXIBILITY**—VEDIT PLUS lets you edit up to 37 files simultaneously. So you can cut and paste. Edit programs. Edit text. Even perform numerous search/replace functions in several files without user intervention.\*
- **CUSTOMIZATION**—With VEDIT PLUS, you can create your own on-line editing functions with keystroke macros. Develop your own on-line help screens. Determine and revise your own keyboard layout easily.

- **SPEED**—VEDIT PLUS not only works hard, it works fast. Faster, in fact, than any other text editor on the market.
- **EXPERIENCE**—Six years ago, CompuView revolutionized the concept of microcomputer text editing. And we've been improving our products and services ever since.

---

**Special Offer: Order a VEDIT PLUS text editor for \$225 and we'll include our V-PRINT<sup>™</sup> document formatter—a \$120 value—absolutely free.**

---

Call CompuView today at 313/996-1299. You'll be in good company.

# CompuView<sup>®</sup>

CompuView<sup>®</sup> Products Inc., 1955 Pauline Boulevard—Suite 300, Ann Arbor, Michigan 48103, TELEX 701821

Available for PC DOS, MS-DOS, CP/M, CP/M-86.

\*Free sort, compare, print and main menu macros included; optional 8080-8086 translator or mailmerge, \$50 each.



# Opening Bids In Bridge

## An Expert System

By Margaret M. Sklar

Mgmt, Mktg, & C.I.S. Dept.  
Northern Michigan University  
Marquette MI 49855

*In the life of every new language there comes a point where it's time to stop talking and start writing. In this article, Margaret lets her code do most of her talking. It's not a bad way to learn PROLOG and expert system design.*

In an accompanying article ("Expert Systems And Logic Programming") Dr. R. Bharath discusses the fundamentals of expert systems programming. In this article, I'll present a simple expert system (called BRIDGE) for determining opening bids in bridge.

BRIDGE decides an opening bid based on an input hand and a set of production rules which evaluate the holding and determine the bid. While the system can be expanded to include more of the bridge auction, I've included only the basic bidding rules.

The five essential facets of an expert system discussed by Dr. Bharath (Knowledge Base, Inference Engine, Explanation Subsystem, Natural Language Interface, and Knowledge Acquisition/Refinement System) are all present in my expert system.

I'll review each of the facets and show its code (in PROLOG). PROLOG's goal-seeking methods make it particularly suitable for this type of program.

### Knowledge Base

The Knowledge Base contains the facts and rules necessary to decide a bid, the information —

1. That spades and hearts are major suits
2. That diamonds and clubs are minor suits
3. Which suits can be considered "touching"
4. Whether the hand has even distribution

5. Which is the longest suit (or suits if there are two or more equally long ones)
6. A list of all of the cards held in each suit
7. Information about the total points in the hand
8. The point count and card count of each suit
9. The bid

See Figure 1 — "Facts In The Knowledge Base."

The facts "major," "minor," and "touching" are static and can be considered definitions. All of the other facts are updatable by information input by the user.

The Knowledge Base also contains the basic rules on which the system operates (Figure 2) —

1. List processing rules
2. A rule to determine if a given hand has even distribution
3. Rules for finding the longest and next longest suits
4. Rules for evaluating the hand
5. A rule for constructing a list of cards held in the individual suits

Also included is a more complex rule for deciding the opening bid (Figure 3).

A Knowledge Base can be extensive, since it needs to hold all of the system's working knowledge. The Knowledge Base includes basic facts plus the rules which specify how those facts and how user input will be manipulated.

### Inference Engine

This part of the system uses the Knowledge Base to draw inferences (or conclusions) based on a set of rules. In BRIDGE, the inference engine is simply the PROLOG interpreter.

PROLOG decides the bid by satisfying goals in the decide\_bid rule (Figure 3). Decide\_bid gets information

from a player and prints out a listing of the hand and an appropriate bid.

BRIDGE uses the following rules to determine the bid —

1. If the point count is less than 13, pass.
2. If the point count is between 16 and 18 inclusive, and there's even distribution, bid 1 notrump.
3. If there are two equally long suits, bid the higher ranking of touching suits, or the lower ranking if the suits are not touching.
4. If there's a long suit (6 or more cards), bid that suit.
5. If there's a five-card major suit, bid it.
6. If there's a four-card minor suit containing an honor, bid it.
7. If there's no really biddable suit, but 3 or more clubs, bid clubs.
8. Otherwise, follow Rule 3 with the longest of not-so-long suits.

We want exactly one bid. The rules are evaluated in the order given above. If one succeeds, none of the others is attempted. The short club (Rule 7) is used when there are no biddable suits but opening hand (13 or more) points. Rule 8 is used when even a short club is impossible.

After the bid's decided, it's printed and added to the Knowledge Base as a fact.

For simplicity, the bid is always one of a suit, one notrump, or pass. Deciding an opening two or three bid would be more complex but follow similar procedures.

### Explanation Subsystem

An important aspect of an expert system is its ability to explain how it arrived at a conclusion. This explanation should include information about the rules and the Knowledge Base that led to the conclusion. In BRIDGE, after the bid is decided, the player can ask — ?-why.



and receive an explanation, based on the facts and rules in the Knowledge Base and the Inference Engine. Figure 4 lists the Explanation Subsystem.

### Natural Language Interface

In order to make the system available to casual users, not just to experts, the program is interactive. To begin the decision process, enter the query:

?decide\_bid.

prompts BRIDGE to get information about the hand. The get\_values rule (Figure 5) is called from decide\_bid and prints the message —

Enter your hand at the prompts

It then calls on the get\_suits rule four times to ask for information about each suit. (You answer 'y.' or 'n.' about honors and specify low cards with numbers followed by periods.)

To use the system, you need only know that entering "decide\_bid." will start the decision making process and that entering "why." will explain the process. A more sophisticated user could, of course, call any of the other rules or query other facts in the knowledge base as well.

### Knowledge Acquisition & Refinement

The Knowledge Acquisition Subsystem (I/O) is an ongoing part of the program. Information is entered and saved regarding the hand, suits, etc.

It can be argued that the bid fact is "learned," so, alternatively, a list of hands and bids could be remembered. The "learned" facts would be searched before the decide\_bid options were checked. I've ignored this alternative in BRIDGE.

Figures 2 through 5 contain the information-gathering rules.

Since these rules also update the Knowledge Base, they serve the Knowledge Acquisition function as well as their primary function.

■ ■ ■

Figures 2 through 5  
on pages 20 through 23.

Figure 1 - Facts In The Knowledge Base

```
/* which suits are major and minor */
major(spades).
major(hearts).
minor(diamonds).
minor(clubs).

/* which suits are touching */
touching(spades, hearts).
touching(hearts, diamonds).
touching(diamonds, clubs).
touching(clubs, spades).

/* is the hand evenly distributed */
even_distr(no).

/* Indicate the longest suit(s) */
longest(spades, 5).
longest(hearts, 5).

/* Give more detailed information
on the hand -- one fact
for each possible honor (ace,
king, queen, jack) and one fact
for the number of small cards
in a suit. */
values(clubs, small, 0).
values(clubs, y, 1).
values(clubs, n, 2).
values(clubs, n, 3).
values(clubs, n, 4).
values(diamonds, small, 1s).

/* Contains the list of cards in
the specified suit. */
hand(clubs, [jack]).
hand(diamonds, [queen, x]).
hand(hearts, [ace, jack, x, x, x]).
hand(spades, [ace, king, x, x, x]).

/* Tell the # of points and cards
in a suit. */
points(clubs, 1, 1).
points(diamonds, 2, 2).
points(hearts, 5, 5).
points(spades, 6, 5).

/* Contains the value of the hand */
hand_count(17).

/* Contains the value of the bid. */
bid([1, spades]).
```



Figure 2 - Rules In The Knowledge Base

List-Processing Rules:

```
/* Determine whether an item is
an element of a given list. */

member(X, [X |_]).
member(X, [_| Y]) :-
member(X, Y).

/* Tells how to build one list
from two distinct lists. */

append([], X, X).
append([X|L1], L2, [X|L3]) :-
append(L1, L2, L3).

/* Tells how to add a single item
to a list if the item is not
already on the list. */

add_to_list(X, Y, L) :-
not(member(X, Y)),
append([X], Y, L).

/* When building the list of cards
held in each suit, a small card
is represented as an "x". This
rule is used to add an "x" for
each of the small cards held.
The rule is called from the
X is C - 1, build_list rule;
C represents the
number of small cards to add. */

add_small(Suit, 0) :- !.
add_small(Suit, C) :-
hand(Suit, L),
append(L, [x], Newlist),
retract(hand(Suit, L)),
asserta(hand(Suit, Newlist)),

add_small(Suit, X).

/ * Note how this rule uses
recursion. The last statement,
"add_small(Suit,X)" calls itself
with the updated value of X
(each time, X is one less than
previously). Add_small is
terminated when X reaches 0.
```

The cut operator (!) is important here because it prevents further attempts to satisfy the goal add\_small (Suit, C) in the event that C is 0. The statements retract and asserta are used to erase old values and insert new values into the Knowledge Base. \*/

/\* Even Distribution Rule: \*/

```
/* Begins by clearing out any
even_distr fact and using the
default value "no". */
```

```
balanced_hand :-
retractall(even_distr(X)),
asserta(even_distr(no)).
```

```
/* A hand is considered "balanced"
if there are neither very short
nor very long suits. If either
of these is encountered, the
default value "no" is kept.
Otherwise, the hand is balanced
and the "yes" value is stored. */
```

```
balanced_hand :-
points(Suit, Points, Count),
Count < 3, !.
```

```
balanced_hand :-
points(Suit, Points, Count),
Count > 5, !.
```

```
balanced_hand :-
retractall(even_distr(X)),
asserta(even_distr(yes)).
```

```
/* The cut operator is used again
in this rule. As soon as the system
determines that there is either a
long or a short suit, checking
stops immediately. */
```

```
/* Find the longest suit(s). */
/* Initialize the count to 0. */
```

```
find_longest_suit :-
retractall(longest(Suitname, Count)),
asserta(longest(none, 0)).
```

```
/* Checks each of the points facts
to determine if a count value is
larger than the currently stored
If so, that value and
its corresponding suit name replace
the previously stored values. */
```

```
find_longest_suit :-
points(Suit, Points, Count),
longest(Suitname, Suitcount),
Count > Suitcount, value.
retract(longest(Suitname, Suitcount)),
asserta(longest(Suit, Count)).
```

```
/* Looks for a second (or third)
suit having the longest count
as determined above. */
```

```
find_next_long_suit :-
longest(Suitname, Suitcount),
points(Suit, _, Count),
not(Suit = Suitname),
Count = Suitcount,
asserta(longest(Suit, Count)).
```

/\* valuating the Hand: \*/

```
/* Initializes all point and
count values to 0 for the
individual suits. */
```



```

val_hand :-
retractall(points(Suit, Points, Count)),
asserta(points(spades, 0, 0)),
asserta(points(hearts, 0, 0)),
asserta(points(diamonds, 0, 0)),
asserta(points(clubs, 0, 0)).

```

```

/* Calls on the get-count rule
to evaluate each suit, and
finally on the count_hand
rule to evaluate the entire hand */

```

```

val_hand :- get_count(spades).
val_hand :- get_count(hearts).
val_hand :- get_count(diamonds).
val_hand :- get_count(clubs).
val_hand :- count_hand.hand.

```

```

/* Counting the Points and the Cards
in the Hand: */

```

```

/* This rule will be called on
when evaluating the hand. It
is called on once for each
First, it accumulates
into the card count for the
individual suit the number of
"small" cards held in that suit. */

```

```

get_count(Suit) :-
values(Suit, Honor, Points),
Honor = small,
points(Suit, P, Count), suit.
Newcount is Count + Points,
retract(points(Suit, P, Count)),
asserta(points(Suit, P, Newcount)).

```

```

/* Next it gets the point
count for each
honor and increments the suit count
eachtime an honor is encountered. */

```

```

get_count(Suit) :-
values(Suit, Honor, Points),
not(Honor = small),
Honor = y, honor (Ace = 4, King = 3,
points(Suit, P, Count), Queen = 3, Jack = 1)
Newcount is Count + 1,
Newpoints is Points + P,
retract(points(Suit, P, Count)),
asserta(points(Suit, Newpoints, Newcount)).

```

```

/* Finally, if there are more than 4
cards held in a suit, a point is
added for each card in excess of 4.
Generally, this works as well
as the more common method of
counting short suits and is
preferred by some bridge experts. */

```

```

get_count(Suit) :-
points(Suit, Points, Count),
Count > 4,
Newpoints is Points + Count - 4,
retract(points(Suit, Points, Count)),
asserta(points(Suit, Newpoints, Count)).

```

```

/* Sets up a hand_count fact that
counts the number of total points
in the hand based on the suit
points calculated in the above.
After the hand count is tallied,
a message is printed indicating
the point count of the hand. */

```

```

count_hand :-
retractall(hand_count(X)),
asserta(hand_count(0)).

```

```

count_hand :-
points(Suit, Points, Count),
hand_count(X),
Newpoints is X + Points, rule.
retractall(hand_count(X)),
asserta(hand_count(Newpoints)).

```

```

count_hand :-
hand_count(Points),
print('Your hand is worth ', Points, ' points').

```

```

/* building the Hand List: */

```

```

/* This rule is invoked to clear
out the suit lists before the
suits are rebuilt based on
current information. */

```

```

clear_suits:- retractall(hand(Suit, Hand)).
clear_suits:- asserta(hand(spades, [])),
asserta(hand(hearts, [])),
asserta(hand(diamonds, [])),
asserta(hand(clubs, [])).

```

```

/* This rule calls on the list-
processing rules to build a
list from the facts found in
the values set. The add_small
rule is called on to add an "x"
for each small card.
The add_to_list rule is called
on to add the name of the honor
to the list when appropriate. */

```

```

build_hand(Suit) :-
values(Suit, y, 2),
hand(Suit, L),
add_to_list(queen, L, Newlist),
retract(hand(Suit, L)),
asserta(hand(Suit, Newlist)).

```

```

build_hand(Suit) :-
values(Suit, y, 3),
hand(Suit, L),
add_to_list(king, L, Newlist),
retract(hand(Suit, L)),
asserta(hand(Suit, Newlist)).

```

```

build_hand(Suit) :-
values(Suit, y, 4),
hand(Suit, L),
add_to_list(ace, L, Newlist),
retract(hand(Suit, L)),
asserta(hand(Suit, Newlist)).

```

End of Listing



Figure 3 - Making the Decision: Rules for Determining the Bidding

```
decide_bid :- retractall(bid(X)).
decide_bid :-
retractall(values(Suit, Honor, Points)).
```

```
/* After the hand is entered, a
listing of the hand is printed.
The rest of the clauses decide
the bid based on the rules set up
in 1 thru 8 (See text)
Rule 1: there are fewer than 13 pts */
```

```
decide_bid :- get_values.
decide_bid :- eval_hand.
decide_bid :- clear_suits.
decide_bid :- build_hand(spades).
decide_bid :- build_hand(hearts).
decide_bid :- build_hand(diamonds).
decide_bid :- build_hand(clubs).
decide_bid :- print_hand.
decide_bid :-
hand_count(Count),
Count < 13,
print('Pass'),
asserta(bid(pass)), !.
```

```
/* Rule 2: there is even distribution
and between 16 and 18 points -
1 notrump. */
```

```
/* Rule 3: Bid the higher ranking of
touching suits
or the lower ranking if two long
suits are not touching. */
```

```
/* Rule 4: Bid the long suit. */
```

```
/* Rule 5: Bid a five-card major */
```

```
/* Rule 6: Bid a four-card minor
suit if it has an honor. */
```

```
/* Rule 7: Bid one club. */
```

```
/* Rule 8: Bid the best of suits
which are not biddable by rules
1 through 6. */
```

```
/* The use of the cut operator
at the end of each clause. It is
essential to stop the process
as soon as the proper bid is
determined. */
```

```
decide_bid :- balanced_hand.points - pass.
decide_bid :-
even_distr(yes),
hand_count(Count),
Count > 15,
Count < 19,
print('1 notrump'),
asserta(bid([1, notrump])), !.
decide_bid :- find_longest_suit.
decide_bid :- find_next_long_suit.
decide_bid :-
longest(Suit, Count),
Count > 4,
longest(Suit2, Count),
not(Suit = Suit2),
touching(Suit, Suit2),
print('1 ', Suit),
asserta(bid([1, Suit])), !.
decide_bid :-
longest(Suit1, Count),
Count > 4,
longest(Suit2, Count),
not(Suit1 = Suit2),
print('1 ', Suit2),
asserta(bid([1, Suit2])), !.
decide_bid :-
longest(Suit, Count),
Count > 5,
print('1 ', Suit),
asserta(bid([1, Suit])), !.
decide_bid :-
points(Suit, Points, Count),
Count > 4,
major(Suit), suit.
print('1 ', Suit),
asserta(bid([1, Suit])), !.
decide_bid :-
points(Suit, Points, Count),
Count > 3,
minor(Suit),
values(Suit, Honor, Pts),
Honor = y,
print('1 ', Suit),
asserta(bid([1, Suit])), !.
decide_bid :-
points(clubs, Points, Count),
Count > 2,
print('1 club'),
asserta(bid('1 club')), !.
decide_bid :-
longest(Suit, Count),
Count > 3,
longest(Suit2, Count),
not(Suit = Suit2),
touching(Suit, Suit2),
print('1 ', Suit),
asserta(bid([1, Suit])), !.
decide_bid :-
longest(Suit1, Count),
Count > 3,
longest(Suit2, Count),
not(Suit1 = Suit2),
print('1 ', Suit2),
asserta(bid([1, Suit2])), !.
decide_bid :-
longest(Suit, Count),
Count > 3,
print('1 ', Suit),
asserta(bid([1, Suit])), !.
```



End of Listing



Figure 4 - The Explanation Subsystem

```

why:- print_hand.
why:- hand_count(Points),
Points < 13,
print('You have ',Points),
print(' points. This is not enough to open'), 1.
why:- bid([1,notrump]),
hand_count(Points),
print('Your hand is worth ',Points, ' points'),
print('You have balanced distribution 16&18 pts'),
print('In this situation you bid 1 notrump'), 1.
why:- bid([1,X]),
points(X, Points, Count),
longest(Suitname1, Count),
longest(Suitname2, Count),
not(Suitname1 = Suitname2),
print('You have 13 or more points'),
print('You have 2 suits each with ',Count,' cards. '),
print('Bid the higher ranker of two touching suits'),
print('or the lower if the suits don't touch'), 1.
why:- bid('1 club'),
print('You do not have a biddable major suit'),
print('Your diamond suit does not contain an honor'),
print('Your club suit isn't biddable, but you must open'),
print('This is a short club situation'), 1.
why:- bid([1,X]), points(X, Points, Count),
print('You have ', Points, 'pts and ', Count, 'Cards in ',X),
print('Bid your longest suit').
print_hand:- print('Your hand is:').
print_hand:- hand(Suit, List),
print(Suit, ':'),
tab(5),
print(List),nl.

/* why" calls on the print_hand rule first to give a complete
listing of the hand as contained in the knowledge base. It
then checks for a hand worth fewer than 13 points. If this is
the case, the message printed is that there are not enough
points to open. If there are more than 13 points in the hand,
then the bid fact (created by the decide_bid rule) is checked
to see what the bid was, and other pertinent facts in the
knowledge base are checked to help with the explanation. */

```

Figure 5 - The Natural Language Interface

```

get_values :-
print('Enter your hand at the prompts'),
get_suits(spades),
get_suits(hearts),
get_suits(diamonds),
get_suits(clubs).

/* get_values is called from decide_bid. It prints a prompt,
then calls the get_suits rule for each suit. */

get_suits(Suit) :-
print(Suit),
print('Ace - y/n'),
read(Ace),
asserta(values(Suit, Ace, 4)),
print('King - y/n'),
read(King),
asserta(values(Suit, King, 3)),
print('Queen - y/n'),
read(Queen),
asserta(values(Suit, Queen, 2)),
print('Jack - y/n'),
read(Jack),
asserta(values(Suit, Jack, 1)),
print('How many small ', Suit, ' are in your hand? '),
read(Small),
asserta(values(Suit, small, Small)).

/* get_suits(Suit) will build the set of values facts as well
as get information from the user. It consists of a series of
prompts, each requiring a yes/no answer (or a number in the
case of "How many small..."). When the answer is received, a
values fact is retained recording this information. These
facts are then used as input to the rules which build the
suits, calculate the hand value, etc. These rules help decide
the bid and later explain how the bid was determined. */

```

# PORTABLE POWER WITH MasterFORTH



Whether you program on the **Macintosh**, the **IBM PC**, an **Apple II** series, a **CP/M** system, or the **Commodore 64**, your program will run unchanged on all the rest. **IBM**™



If you write for yourself, **MasterFORTH** will protect your investment. If you write for others, it will expand your marketplace.



Forth is interactive - you have immediate feedback as you program, every step of the way. Forth is

fast, too, and you can use its built-in assembler to make it even faster. **MasterFORTH's** relocatable utilities and headerless code let you pack a lot more program into your memory. The resident debugger lets you decompile, breakpoint and trace your way through most programming problems. A string package, file interface and full screen editor are all standard features. And the optional target compiler lets you optimize your application for virtually any programming environment.

The package exactly matches *Mastering Forth* (Brady, 1984) and meets all provisions of the Forth-83 Standard.

MasterFORTH standard package.....\$125  
(Commodore 64 with graphics).....\$100

#### Extensions

Floating Point.....\$60  
Graphics (selected systems).....\$60  
Module relocater (with utility sources).....\$60  
TAGS (Target Applic. Generation System)-  
MasterFORTH, target compiler and  
relocater.....\$495

#### Publications & Application Models

Printed source listings (each).....\$35  
Forth-83 International Standard.....\$15  
Model Library, Volumes 1-3 (each).....\$40

(213) 821-4340



**MICROMOTION**

8726 S. Sepulveda Bl., #A171  
Los Angeles, CA 90045



**MSO**  
**MICRO**  
**SUPPLY**  
 ORGANIZATION INC.

# dare to compare.

**Don't be fooled.**  
**No hidden cost!**  
**Complete MS-DOS/CPM**  
**Super Turbo**

In keeping with industry trends MSO is bringing our customers high performance P.C. compatibles and accessories. MSO takes the P.C. compatible to maximum performance with its SUPER TURBO. The SUPER TURBO features the V20-8 chip which runs at three times the speed of the IBM-PC XT\* and also runs CPM 8080 software.

The SUPER TURBO comes complete with the MS-DOS operating system, Read and Run CPM, full Instructional Documentation, Utility software, **plus for our first 100 customers MSO is offering the Micropro Wordstar Professional Software package. This package includes: Wordstar, Mailmerge, Correctstar, Starindex, Datastar and a G.L. Accounting System.** The SUPER TURBO is a complete turnkey system with everything necessary to plug in and operate.

**USER SUPPORT**  
**HOT LINE**

**805/393-2247**

All systems carry full 90 day warranty.

**CASH PRICE ONLY**

Check in advance. Add 3% for VISA/MC. Shipping & handling charges will be added to each order.

**For our catalog with complete details and prices, send \$2.00 to:**

Micro Supply Organization, Inc.  
 4909 Stockdale Hwy. #180  
 Bakersfield, CA 93309

MON. - FRI. 7am - 5pm PST • SAT. 9am - 5pm PST

\*IBM is a registered trademark of the IBM Corporation.  
 15% restocking on returned orders

Super Turbo  
 Super Price:

**\$1299**



**The Super Turbo P.C. runs IBM software and CPM 8080 programs**

- CPU - V20-8 8mHz Super Chip runs \*IBM compatible software at 3 times the speed of the IBM-XT and CP/M 8080 software.
- 8087 Math Processor optional
- 256K RAM on mother board expandable to 640K
- ROM 8K Bios
- 6 empty slots for expansion
- 2 serial port one optional with expansion kit
- 1 parallel port
- 1 game port
- Clock calendar with software
- Hi-Res monographics video board
- Floppy controller
- Dual Floppy Drives 360K ea.
- 135 watt XT Power Supply
- 5150 style compatible keyboard
- Hi-Res TTL Green or Amber 12" monitor
- MS-DOS operating system and manual.
- Instructional Documentation and Utility Software
- Assembled and tested in U.S.A.
- **Optional internal 20 meg sub system for Super Turbo add \$499**

**Special printer pricing with purchase of above computer.**





# the alternative.

## The SANYO complete word processing system

The alternative for WANG, Xerox or any dedicated word processing system.

At Micro Supply Organization we offer the lowest prices on Sanyo computers and software. With prices like these you can afford the convenience of owning and operating more than one computer. We also offer the User Support Hotline for questions concerning your computer or about software availability. Whether you need one or a dozen computers, Micro Supply Organization is the place to get them!

### The MBC 1160 Accounting Software

We carry a complete line of ADS accounting business software. Buy G/L, A/R, A/P, Inventory and receive the Payroll module **FREE**. The current retail price is \$398. per module. **Now from MSO you pay only \$99 per module.**

20 meg internal hard drive sub-system for SANYO MBC 1150, 1160 & 1250. **\$649**

### USER SUPPORT HOT LINE

**805/393-2247**

All systems carry full 90 day warranty.

#### CASH PRICE ONLY

Check in advance. Add 3% for VISA/MC. Shipping & handling charges will be added to each order.

For our catalog with complete details and prices, send \$2.00 to:

Micro Supply Organization, Inc.  
4909 Stockdale Hwy. #180  
Bakersfield, CA 93309

15% restocking on returned orders



## Get more for your money!

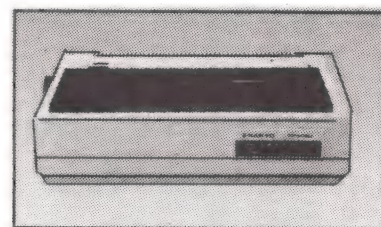
### SANYO MBC 1160

Including this **FREE** software:

- Wordstar • Spellstar
- Mailmerge • Calcstar
- Infostar • BASIC

#### 8-Bit Integrated Computer with 640KB Formatted Mini Floppy Disk Capacity

- Z-80A CPU with no-wait mode and large 64KB RAM/4KB ROM memory capacity for fast execution.
- CP/M operating system with editor, assembler and all standard utilities.
- No-glare amber monitor display screen for easy viewing.
- 80-character x 25-line display 256 characters in 8 x 12-dot matrix cells.
- Two internal double-sided, double-density, double-track 5 1/4" slim-type mini floppy disk drives with 640KB formatted capacity.
- Interfaces for one Centronics printer and one RS-232C port.
- Optional interface for hard disk drive and for external 8" floppy disk drive.



### LEGEND 880 OR SANYO PR 5000 Dot Matrix Printer

- 80 char/line or dot-image graphics
- Centronics parallel interface
- Tractors or Friction feed
- Pica, elite, condensed or proportional

Includes printer cable & full warranty

#### Letter quality Daisy Wheel Printer

- Letter-quality printer with 96-character daisy wheel printing element.
- Accepts paper up to 13 inches in width.
- 14 cps bidirectional printing.
- 10, 12 and 15 cpi printing pitches.
- Centronics parallel interface.
- Optional form tractor.

Includes printer cable & full warranty.

This complete package Computer & Printer lists for \$3194.00

**ONLY \$699**



# Building Your Own Inexpensive Logic Analyzer

By Don Fletcher

University of Missouri at Columbia  
Rt. 7 Box 120  
Columbia MO 65202  
(314) 443-7294

*Logic analyzers are expensive, mysterious gadgets that experts use to find subtle problems in inscrutable systems. At least that's been the case until now.*

*This is the first of two articles on building your own logic analyzer. Once you've used one of these gadgets you'll wonder how anyone debugs software (and hardware) without one. Of course, at their usual prices of \$5,000 to \$25,000 there hasn't been too much demand from individuals. With this series, all that changes. There are no more excuses for not knowing what's happening inside a system.*

It's late, and you've just completed the prototype of your automatic canary feeder-burper, the best microprocessor real time controller designed for that purpose. You key in the code, flip the on switch, and are greeted by — nothing; it just sits there.

Or you've just finished writing a wonderful 20,000 line, single module assembly language program to automate the manufacture of gopher corsets. Following the procedure taught you by "tune-for-greatest-smoke" Kelly back in school, you assemble and then run the program only to be treated to the sound of several myopic gypsies singing "Marching to Albuquerque" on the assembly line stepper motors.

## What Do You Do?

You could reach for the trusty scope, but you'd have a tough time trying to solve these problems. The scope has its uses, but it suffers from two major faults when working on bus-structured equipment: it has a limited number of display channels (usually 1 to 4), and it must have a recurrent (periodic) waveform to be of much help.

You'd need 30 or more display chan-

nels to watch what the newer processors were doing. Plus, scopes have a difficult time displaying aperiodic (one time) signals.

Since microprocessors are driven by software (much as programmers are driven to drink by it), it would help to capture the program off the busses, and determine the exact path taken, or not taken, by the program.

The magical device that allows us to watch a computer or any other bus structured equipment in action is called a logic analyzer, and it has been with us in different forms and price ranges for a couple of decades.

This article will describe the component parts of an ideal logic analyzer and propose a working design that can be used with the PC family of computers, at a parts cost of under one hundred dollars.

## The Logic Analyzer & The Scope

Both the logic analyzer and the scope view a signal vs. time. The scope displays an analog signal (any level allowed) continuously in time.

The logic analyzer is a digital (TTL or CMOS) level device which samples and stores the logic state of an input at specific time intervals (usually determined by a system clock along with several clock qualifiers) for later display and use.

Therefore, a scope is like your eyes, viewing surroundings all the time, while the logic analyzer is more akin to a camera, preserving and displaying an instant in time.

While the scope is normally triggered on a certain slope and level of an incoming signal, the logic analyzer compares the logic state present on its incoming channels with a set of trigger states set up by the operator. When the two match, the analyzer starts or stops acquiring data.

Other bells and whistles can be added to enhance the basic system capabilities as described below.

In summary — the scope is an analog, periodic waveform display instrument while the logic analyzer is a clocked, digital, aperiodic sampler.

## Block Diagram Description

The first requirement of a logic analyzer is input lines, lots of input lines.

For example, if you're working on a Z80 system, such as the Big Board family, you'll need inputs for 16 address lines and 8 data lines for a total of 24 input channels.

If you're using 16-bit microprocessors, you'll need up to 24 address lines and 16 data lines, for a total of 40 input channels.

Some type of buffering will be required to isolate and reduce loading of the system under test. To reduce the logic board density and the system under test bus loading, we'll put the input signal isolation buffers in the probe.

It's usually a good idea to stick to powers of two for anything that must be filtered through TTL logic. So we'll choose 32 input lines, a workable compromise between maximum number of signal lines that are a power of two.

A number of the input signal lines should be available for comparison with a trigger word to start or stop the sampling process.

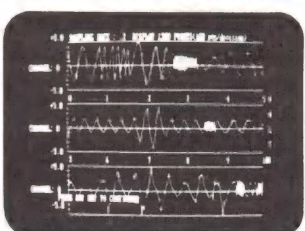
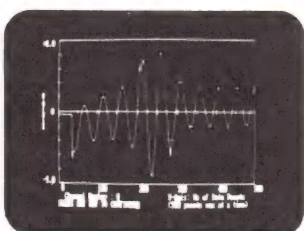
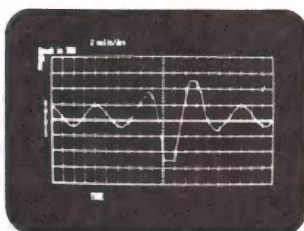
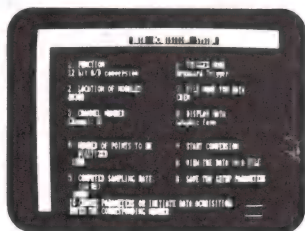
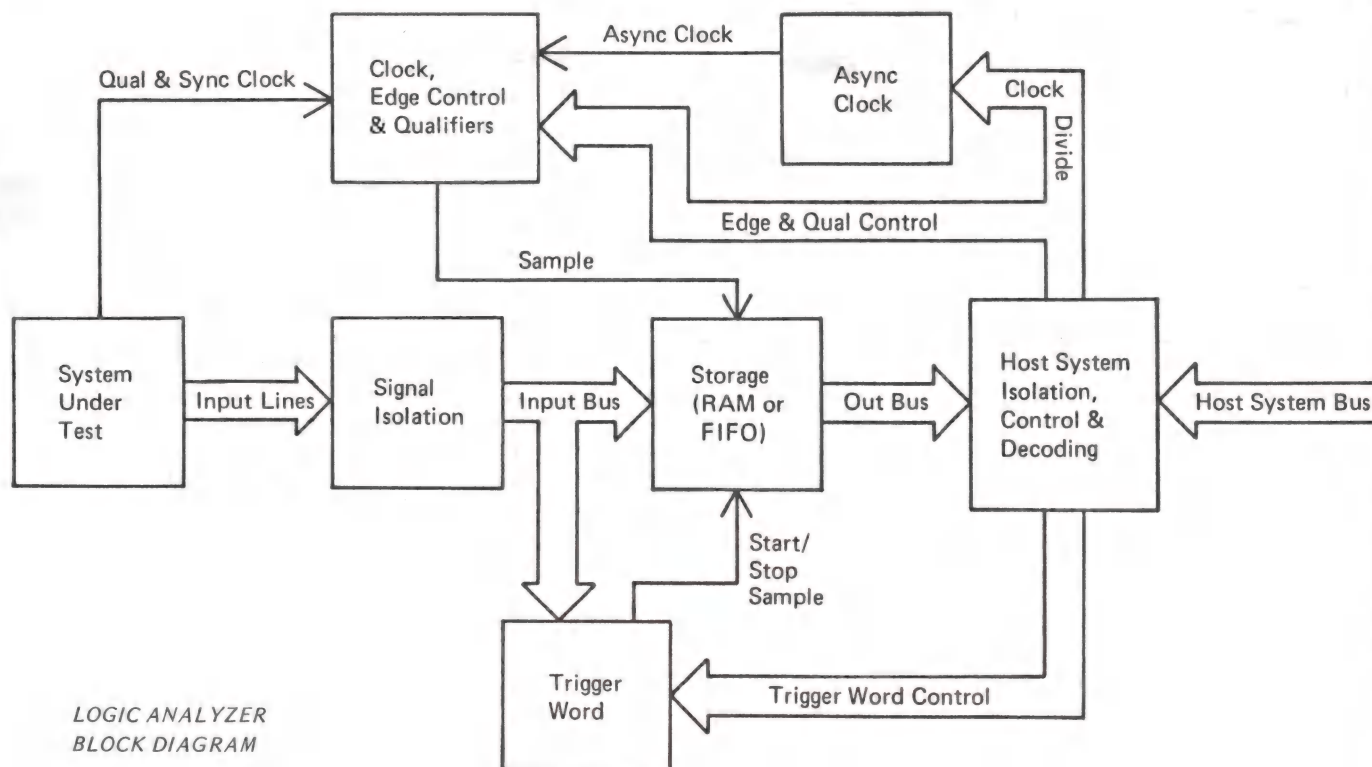
If, for example, you know the system is running correctly until address 00F0H, that would be the initial trigger word set for the address line inputs. After viewing the block of data acquired starting at this address, a higher address can be specified to obtain the next block of data.

## High, Low, Don't Care

Three states are required for signal comparison: high, low, and don't care (input can be either high or low). When approaching a new prototype

(continued on page 28)





## MODULAR DATA ACQUISITION SYSTEM

**We Bring Engineers, Scientists And The IBM-PC Together.** Our unique high-performance modular data acquisition system allows you to purchase the configuration that exactly meets your requirements. All of Qua Tech's data acquisition products include LABSTAR, powerful software designed to give BASIC programmers total control of their application.

**\$490** 8-BIT A/D SYSTEM

**\$690** 12-BIT A/D SYSTEM



**QUA TECH, INC.**

478 E. Exchange St. Akron, OH 44304

**CALL NOW**

**(216) 434-3154**



(continued from page 26)

(with due caution, they bite), you would normally set the qualifiers to "don't cares" just to get some idea of what's on the busses.

The number of samples that can be obtained in one run is determined by the logic analyzer storage capacity. So information about the system bus activity is obtained in chunks, each of which guide you closer to the problem.

In some logic analyzers, the trigger word can be at the beginning or ending of an acquired block of data. Triggering at the end of the data block allows you to view data before an event, such as before an endless loop. To try to keep the parts count within reason, we'll define 16 of our 32 input lines as trigger inputs.

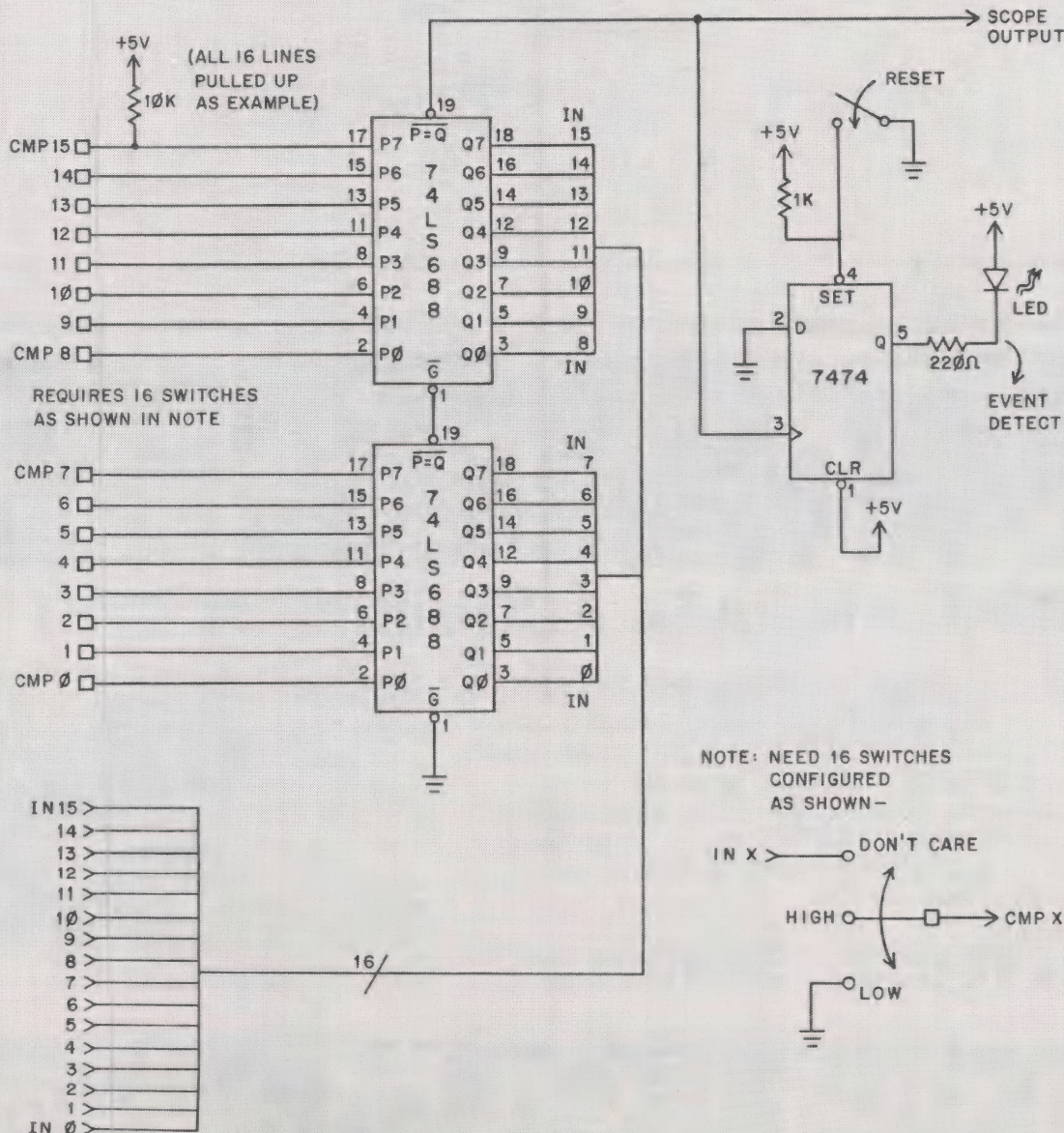
## An LED Circuit

See Figure 1 for a simple circuit that allows you to compare a 16-bit trigger

word with 16 signal inputs.

The LED circuit output shows if the chosen trigger word appeared on the system bus, while the scope output allows you to externally trigger a scope on the output and thus monitor the signal lines referenced to this point. Remember, the scope won't work unless you can create a periodic (repeating) signal. If you don't have any 74LS688s in your junk box (pardon me, your surplus parts storage repository), you can use 7485s instead.

Figure 1 - Bus Capture





The clock output from the system under test, the heart of the logic analyzer, should be edge programmable allowing sampling of data on either the rising or falling edge.

Also needed are several qualifiers that allow a clock transition only under specific conditions, such as read status, write status, I/O status, and so forth.

For example, if you're interested in microprocessor read activity, you would attach an active low clock quali-

fier to the -RD line. This is ANDed with the system clock, and allows a clock transition only when the proper clock edge is present and the read input is low.

Several clock qualifiers are necessary to allow maximum flexibility. Since the 7485 allows comparison of four lines, we'll use four qualifiers in our system.

#### Asynchronous Selectable Period Clock

An additional "nice to have" option would be an asynchronous, selectable

period clock which would let us simulate a scope while troubleshooting circuits that don't have a master clock, but still require viewing of many input lines. How would you like to generate an entire logic board timing diagram (32 lines) at once? What power!

When using the asynchronous clock, the qualifiers would be disabled since the object now is to obtain a timing diagram which requires accurate time sampling and measurement.

Since the asynchronous clock can be simply generated by using the synchronous clock input and a periodic pulse generator such as an LM555, we'll reserve this feature as an option.

Being able to delay after trigger a set number of clock cycles helps speed up the sampling process because the trigger word can be set to a standard value and only the clock delay changed.

If you can store 256 samples starting from a given trigger word, you can start with a clock delay of 0 for the first block, a delay of 256 for the second block, 512 for the third and so on.

Of course, you could change the trigger word for each block, but it's often difficult to pick a unique trigger for every point.

A clock delay feature allows the choice of a single unique trigger word, with blocks offset from that unique point. This feature is much like the delayed sweep on a scope. Since this feature is another "nice to have," we'll enter it as a desirable option.

#### Storage (For Glitches)

Next you'll need some type of storage for all this nice information you're gathering. There are two choices: fast RAM (50ns or less), or FIFOs (first in, first out) which are fancy shift registers.

FIFOs are easier to use, but expensive and difficult to find. RAM also has more capacity so you can store larger blocks of data. Again, trying to strike a reasonable balance between system cost, circuit complexity, parts density, and availability, let's use RAM.

A glitch is defined as a signal that goes up and down between samples.

## Advanced Concepts "Mini-Winnie" HARD DISK SYSTEMS For your Z-80 Computer!

Our EXTERNAL systems install in seconds! Includes an attractive vertical cabinet with integral P/S and fan, 3 foot cables. Everything necessary to plug in and go!

Our INTERNAL systems do not displace a floppy drive, do not require a power supply upgrade, use the highest technology winchesters available. No compromises.

### COMPLETE SUBSYSTEMS

Plug in and run! Includes software, documents, cables, brackets as req'd.

|                       | \$665.<br>10mb<br>External | \$790.<br>20mb<br>External | \$790.<br>10mb<br>Internal | \$845.<br>20mb<br>Internal |
|-----------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| Kaypro (1,2,4,10)     | ✓                          | ✓                          | ✓                          | ✓                          |
| Big Board I,II        | ✓                          | ✓                          |                            |                            |
| Xerox 820-I,II        | ✓                          | ✓                          |                            |                            |
| Micro Mint SB-180     | Add \$10.                  | Add \$10                   |                            |                            |
| Gemini Zorba          | ✓                          | ✓                          | Add \$20.                  | Add \$20.                  |
| Osborne I             | ✓                          | ✓                          | ✓                          | ✓                          |
| Sanyo MBC-1150/1160   | ✓                          | ✓                          | *                          | *                          |
| AVL Eagle             | ✓                          | ✓                          | *                          | *                          |
| Alspa II              | ✓                          | ✓                          |                            |                            |
| (* Under Development) |                            |                            |                            |                            |

### SPECIALS . . . while stock lasts . . .

5mb External **\$465.** TM602 or equiv. (less P/S enclosure \$395.)  
10mb External **\$495.** CM5616 or equiv. (less P/S enclosure \$425.)  
15mb External **\$535.** CM5619 or equiv. (less P/S enclosure \$465.)  
(call for current specials)

### Drives

|                        |              |
|------------------------|--------------|
| 20mb 3.5"              | \$495.       |
| 10mb 3.5"              | \$439.       |
| 20mb 5.25" HH          | \$439.       |
| 10mb 5.25" HH          | \$279.       |
| 10mb FH SPECIAL (call) | under \$200. |
| 5mb FH SPECIAL (call)  | under \$120. |

### Accessories

|                                      |                   |                     |
|--------------------------------------|-------------------|---------------------|
| Drive cable sets 1.5' - 10.95        | 3' (std.) - 11.95 | 6' - 14.95          |
| Kaypro interface cables (externals)  |                   | 16.67               |
| Host extension cable, 1 foot         |                   | 18.95               |
| "Y" power cable                      |                   | 9.50                |
| Document package (incl. with system) |                   | 8.00                |
| Enclosure 5.25" FH, with P/S - 69.00 |                   | without P/S - 49.00 |

The key to the Mini-Winnie system is the INSTALL program, which links your drive and your computer, the way YOU want it. Extensive menu options allow selection of any ST-506 compatible drive, as 1 to 4 logical drives within CP/M at any drive letter. Diagnostic and format capability provided to match the installation. Distributed in SOURCE form.

We have club, user group, OEM/Dealer programs. Call for quantity schedule. If for any reason you are not satisfied, return for full refund. Special drives warranted for 30 days. Info and manual \$8.00 credited with system purchase. Specials subject to availability.

**ORDER INFO: Call (305) 482-7302.** Terms: UPS cash COD, check or M.O. Please allow 4 weeks for delivery. Fla. add 5% tax. Shipping extra. Please specify desired floppy format.



Advanced Concepts Engineering & Consulting  
8926 S.W. 17 St., Boca Raton, FL 33433

(continued next page)



(continued from page 29)

Glitches are caused by noise spikes in digital circuits, power supply noise, asynchronous counters, phase of the moon, circuit bypassing, operator attitude, and bosses' temper tantrums.

A nice memory option is to provide storage and pulse stretchers to capture the not-so-rare beasts. Unfortunately, glitch detection requires virtual duplication of most of the logic analyzer, so, as nice as this option is, we won't include it.

## PC Interface

All that's left in the specification of our system is the host computer (the PC/XT) interface. Here we'll need some input ports to get the data from logic analyzer storage to PC storage, some output ports for everything we're controlling, and decoding to turn it all on and off at the proper time.

Also we'll need a software driver to take the raw acquired data and put it in readable form (HEX display, timing diagram, disassembled code, etc.) and a way to transfer control information between the XT and the logic board.

To recap, our ideal logic analyzer will have:

- 32 input lines
- 16-bit wide trigger word
- 60ns sample time
- 4 qualifiers (for the clock)
- clock edge select

## Circuit By Circuit

The system under test is isolated by the four 74LS244 buffers placed in the probe module.

The WINDOW output, when high, tri-states the buffers isolating the system under test from the logic analyzer, such as during transfer of the acquired data from the logic analyzer to its host.

When low, the buffers are enabled to allow data flow from the system under test into the logic analyzer. Isolating these four buffers in a separate probe reduces capacitive loading of the circuit under test while also decreasing the logic analyzer circuit board density.

The four qualifiers and the clock are not buffered as they are terminated

into a single 74LS input which a buffer wouldn't improve. If you're using long lengths of input cable (longer than 3 feet), add another buffer to the probe for the qualifiers and the clock.

If you want to be really safe (a belt and suspenders man), separate the clock from the rest of the signal lines and run it through a coax cable. I've had good luck, however, with unbuffered, unseparated qualifiers and clock inputs. I ran all inputs through a 50 line, 36 inch length of ribbon cable, isolating the clock by bracketing it with grounds (the wires on each side were connected to ground).

## Trigger Word

The lower 16 of the 32 input lines are used to set a trigger word which marks the starting location in the data stream. The three legal conditions for the trigger word are set by the 74LS00 Nand gates and the 74LS688 Octal Comparators.

To handle the high or low states, the data input line from the probe buffers, (IN0 -> IN15) is passed (and inverted) by setting its matching data compare line (DC0 -> DC15) high.

These two lines are Nanded together, and the output is passed to the Octal Comparators, which compares it to the system compare (CMP0 -> CMP15) lines. Since the input lines are inverted by the Nand gates, the respective CMP line must be the inverse of the desired trigger state.

The don't-care condition is handled by setting the data compare line low which blocks the input line and sets the Nand gate output high. The system compare line is then set high to match this state. More input lines could be added to the trigger word by adding additional Nand gates and Octal Comparators.

The final output of the chain of comparators is used to latch a high logic analyzer clock enable into the 74LS112 JK Flip Flop which is used to enable the 74LS85 Quad Comparator which handles clock qualification.

When the DONE output from the Address counters goes high (signaling the start of a sampling session), the clock input to the logic analyzer is passed through the first And gate. The second And gate passes it if the four qualifiers match their programmed

states (QUAL0 -> QUAL3), and if the trigger word has enabled the qualifier comparator (the 74LS85). When DONE goes low, the clock stops and the host system, which has been polling the DONE state, takes control.

## Clock

Clock edge inversion is provided by an Exclusive Or gate which is used as a programmable inverter. When the EDGE output is high, the clock is inverted; when low, it isn't.

Since data is strobed into storage on the rising edge of the clock, EDGE low would be rising edge transfer, EDGE high would be falling edge transfer. The ADDR INC output allows the host system to control the address line counters when transferring data.

Under remote operation (system under test controlling the clock) the ADDR INC output is set. When the host system takes control, EDGE is set thus driving -WR high, and ADDR INC is pulsed to increment the address inputs to the RAM.

The sanitized, qualified, and purified clock (-WR output) strobes the input data (IN0 -> IN31) into the 2148 RAM array on its rising edge. The same edge is used to increment the 74LS393 address counters, which changes the address about 40 nanoseconds later, setting the address for the next data strobe.

When the RAM is full, A10 goes high, pulling DONE low as outlined above. The access time of the RAM used will determine how fast you can acquire data. Generally, slow means cheap, fast means expensive, so get the fastest you can afford.

## Host Interface

The host system interface is provided by the address decode circuitry which includes the 74LS04 inverters, 74LS30 8-input Nand gate, and the two 74LS138 decoders. The decoder controlled by the I/O Write input is used for the five 74LS374 output ports and the -RESET line. The I/O Read controlled decoder is used for the five 74LS244 input ports. The Base address for both decoders is 320 Hex which fits in the prototype card locations specified by IBM. If you require a different address space, change the inputs to the 74LS30.



With some effort, the logic analyzer could be used by any host such as the Big Board, Xerox, and Kaypro that has access to a bidirectional data port for D0 -> D7, one enable output replacing the 74LS04s and the 74LS30 (connected to the pin 4 on both 74LS138s), and two outputs for the I/O Read and Write (or one output and an inverter).

#### Software

The software can be as simple or as complex as you wish. In sequence it must:

1. Set the trigger word, qualifiers, and clock edge to the desired configuration.
2. Set ADDR INC high and WIN-DOW low.
3. Reset the address counters and the trigger word latch by addressing the reset location (325 Hex).
4. When DONE is low, set WIN-DOW and EDGE high.
5. Since DONE is low, the address lines to the RAM are set to zero. Load the 32 bits of data through the 4 input ports.
6. Toggle ADDR INC, then load the next 32 bits of data.
7. Repeat 7 until all data is transferred (RAM holds 1024 long words — 32 bits each).
8. Massage and display the acquired data to your liking.
9. Go back to 1, or exit the system.

#### Bells And Whistles

Extras not used in this logic analyzer along with possible ways to include them are:

1. Clock delay — could be added by including a counter in the clock channel and the necessary output lines to program the count delay.
  2. Qualifier don't cares — add 4 Nand gates and 4 output lines.
  3. Stop on trigger word — include extra logic between the trigger word output and the DONE output.
  4. Asynchronous clock — add the counters, clock, output divide control lines, and the logic to switch between the synchronous and asynchronous clocks.
  5. Glitch detection — add another logic analyzer. You'll need separate RAM, ports to handle it, and the necessary pulse stretching for each input.
- I didn't add these options because the parts and cost count were high enough. If you need them, use the base circuit and add to it.

#### Culmination

Since my wife insisted on my doing such non-essential tasks as sleeping and eating, the software will be delayed until the next issue. This gives you time to build the system, and me time to find a new hiding place.

If you must have the nasty stuff

before then, and you have a modem, call (314) 443-7294, ask for Don, and give the coded passage: "I must have my software fix!", and I'll transfer what I have (300 or 1200 baud).

I'm also selling a version of the logic analyzer (see ad in this issue), or boards and parts as a service for Micro C subscribers. Contact me for prices.

#### See you at SOG V

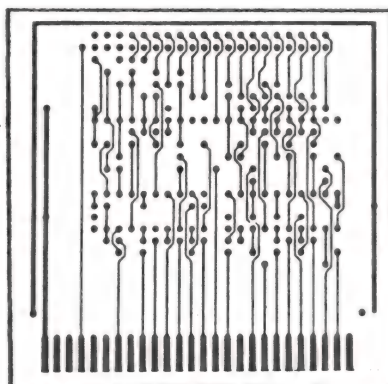
(Editor's note: Don will be speaking at SOG V and he might even have some logic analyzer software with him...).

*Note: Schematic on pages 32 and 33.*

■ ■ ■

## PCB EDIT

- o CREATE PRINTED CIRCUIT BOARDS ON YOUR PC OR XT.
- o MULTIPLE LAYERS
- o PLOTS ARTWORK ON DOT MATRIX PRINTER
- o USER DEFINED PADS, AND PLOT MACROS
- o CPM-80 DUE JULY 1, 86
- o ONLY **\$89.95**



**DON FLETCHER**  
RT 7 BOX 120  
COLUMBIA, MO  
65202  
(314) 443-7294

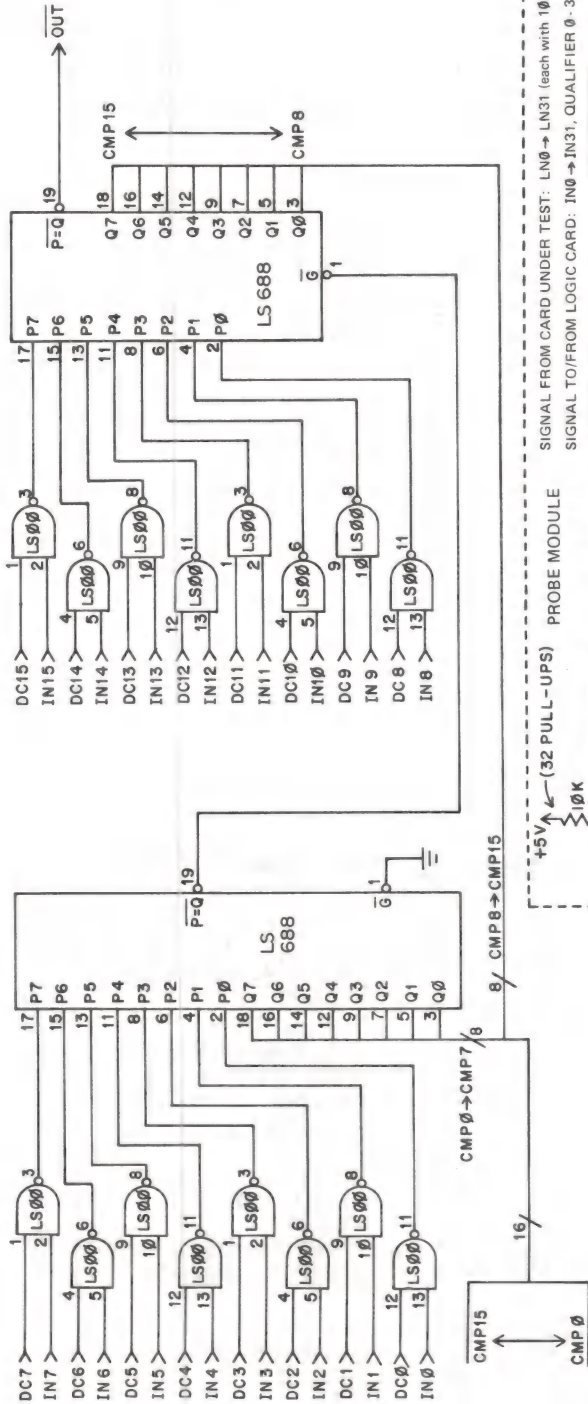
## ANALOGIC

- o 32 CHANNEL LOGIC ANAL FOR THE PC/XT (STAND ALONE CPM-80 VERSION READY JULY 15, 86
- o 16 BIT TRIGGER WORD, 4 CLOCK QUALIFIERS
- o TIMING DIAGRAM, HEX, OR DEBUG/DDT DISPLAY
- o CALL OR WRITE FOR KIT AND BOARD PRICES
- o ONLY **\$389.95**

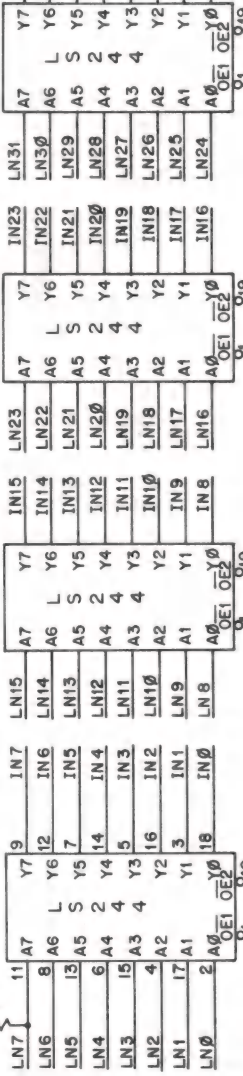


# PC LOGIC ANALYZER

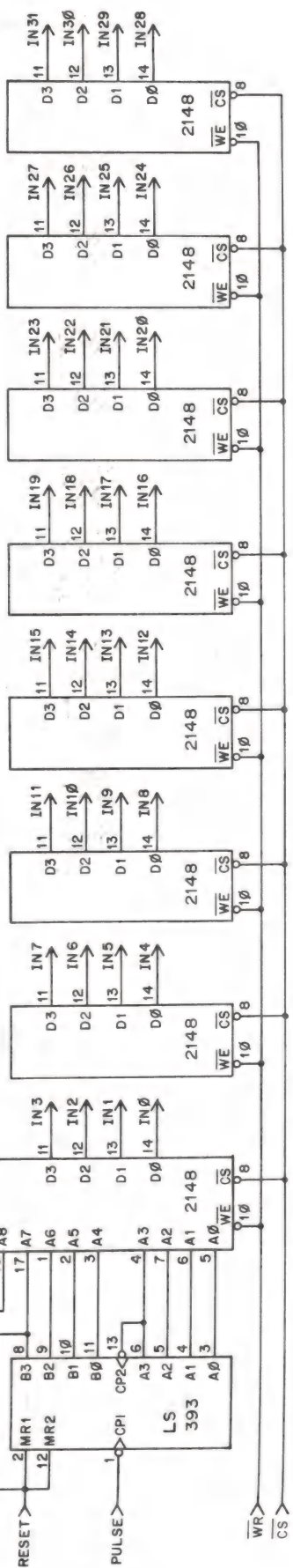
BY DON FLETCHER



SIGNAL FROM CARD UNDER TEST: LN0 → LN31 (each with 10K pull-ups), QUALIFIER 0-3, CLK, GND  
 SIGNAL TO/FROM LOGIC CARD: IN0 → IN31, QUALIFIER 0-3, CLK, GND, WINDOW, +5V



WINDOW  
 DONE



NOTE: A0 → A9 COMMON TO ALL EIGHT RAMs







## XT COMPATIBLE HARD DISK SYSTEM SPECIAL

**\$1159<sup>00</sup>**

XT-type motherboard (4.77 mh) with 256K ram expandable to 640K on board. 10MB hard disk with controller, single Teac floppy with controller, high resolution amber monitor with Hercules compatible monographics card (720 x 348) and parallel printer port, AT-style keyboard (large return, shift, ctrl and tab keys; lighted caps-lock and num-lock indicators), flip-top case, and 135 watt power supply. Aw, what the heck, we'll also throw in a parallel printer cable, assembly and burn-in.

### Upgrades:

|   | Add-on |   |       |
|---|--------|---|-------|
| 4 layer 8mh Turbo<br>(fast, reliable)   | \$149  | 1200 baud modem<br>(Hayes compatible<br>internal, with software). | \$179 |
| 640K memory                             | \$69   |   |       |
| 20 MB hard disk                         | \$189  | Color/graphics card<br>with amber<br>composite monitor.           | \$0   |
| Extra Teac floppy                       | \$109  |   |       |
| Battery clock, serial<br>and game ports | \$50   |   |       |

## XT Compatible Floppy System Special

**\$879<sup>00</sup>**

Same as above but with two Teac floppies and no hard disk.

### CARDS & COMPONENTS

|  |       |
|--|-------|
| XT-type motherboard<br>(2 layers)  | \$129 |
| 8mh Turbo board<br>(4 layers) Multi I/D card<br>(floppy controller<br>battery clock, serial,<br>parallel, game ports.) | \$250 |
| Monographics card<br>(Hercules compatible,<br>includes printer port).  | \$95  |
| Color/graphics card  | \$69  |
| Case - flip top  | \$49  |
| Power Supply (135W)  | \$89  |
| 20 Meg Hard Disk (XT)  | \$489 |
| 20 Meg Hard Disk (AT)  | \$650 |
| Amber TTL Monitor<br>(hi-res monochrome)   | \$110 |
| White TTL Monitor<br>(hi-res monochrome)   | \$130 |
| Amber Monitor<br>(composite with<br>tilt and swivel).  | \$95  |
| TVM Color monitor - RGB  | \$395 |

### WHY 4 LAYERS?

2 layer boards have traces on the top and bottom of the circuit board. 4 layer boards have two extra layers of traces sandwiched between the top and bottom of the board. When comparing a 2 layer board against a 4 layer board of the same size, the 2 layer board will have longer trace runs (which increases the resistance to the signals traveling through the traces) and the traces will be closer together (which increases the possibilities of interference from a neighboring trace). The faster the signals travel through the traces, the more exaggerated these problems become. For those who want to run an XT-type motherboard at 8mh, we recommend a 4 layer board.

### WARRANTY

All products are warranted for 90 days.

### AT BASIC

- 6/8 MHz Motherboard
- 512K RAM
- 1.2 Floppy Drive
- Western Digital H/F Controller
- AT Keyboard
- 200W Power Supply

**\$1889<sup>00</sup>**

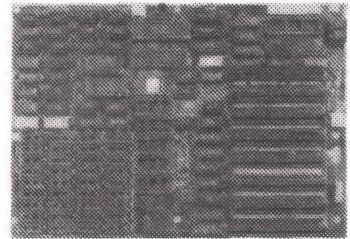
### AT SYSTEM

- 6/8 MHz compatible
- 512K RAM
- TTL Monochrome Monitor
- TTL Monochrome Board
- 20MB Seagate • 1.2 Floppy
- Western Digital H/F Controller
- Keyboard • 200W • Case

**\$2499<sup>00</sup>**

## TURBO PC/XT

16 Bit High Speed  
Personal Computer



The Turbo PC/XT features an enhanced version of the industry standard Intel 8088 micro processor, the 8088-2. In the normal mode, the 8088-2 runs at 4.77MHz. When more power is needed, a simple software command can put the Turbo PC/XT in a high speed mode of 8MHz. Performance is 68% greater than that of the IBM PC and other PC compatibles. For added user convenience, the high speed mode is clearly indicated by an easily visible green LED on the box.

For added effectiveness, the Turbo PC/XT offers powerful hardware and advanced software features to provide a multiple "virtual console" environment. This environment allows multitasking and windowing. Now, users have the ability to accomplish several tasks more quickly than ever before.

The Turbo PC/XT can run on both the Concurrent DOS and MSDOS operating systems. Thus, there is a high degree of compatibility with the extensive library of software designed for the IBM PC. Utilizing the latest in microprocessor technology, the Turbo PC/XT can deliver stronger performance at higher speed without sacrificing software compatibility. The Turbo PC/XT is the ideal computer for OEM's, VAR's and end users who demand personal computer performance together with PC reliability at an economical price.

## SKY HIGH CO. INC.

2158 UNIVERSITY AVE.  
BERKELEY, CA 94704  
(415) 549-3472

### DEALERS

Identify yourself as a dealer and we'll send you dealer information. We're reliable, efficient and price competitive.



# Idea Processing— Pure and Simple.

Announcing the all NEW

## OUT-THINK™ outline processor.

See your ideas like you've never seen them before!

Capture your fleeting ideas. And keep 'em organized with OUT-THINK, the incredible, new outline processor from KAMASOFT. OUT-THINK unleashes the power in your workhorse CP/M computer and turns it into an Idea Processor.

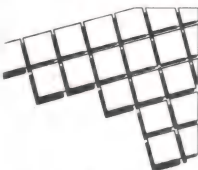
Get extraordinary:

- + ease of use  
Most functions are less than 3 keystrokes away!
- + ease of learning  
Completely interactive; no programming!
- + performance  
Write more and faster than you ever dreamed possible!
- + idea leverage  
OUT-THINK your competition!

OUT-THINK supports your thinking process and keeps you in touch with your ideas. That's because OUT-THINK works the way your mind works—naturally.



Begin by brainstorming. OUT-THINK lets you jot down ideas quickly, as you think of them. If you want to elaborate, you can add text with full screen editing.



Then develop your ideas using a familiar outline format. Change the structure as easily as you change your mind. Move an idea and all

attached text moves with it.

You can keep track of your main line of thought by collapsing the details from view. Then, expand portions of the outline to develop the specifics when you need to. By collapsing and expanding, you can maintain an overview and literally see how your ideas fit together.

And OUT-THINK is fast. Your ideas remain at your fingertips. OUT-THINK can locate and retrieve by keyword—even a misspelled one—in less than a second per outline file.



Once you've entered your ideas, you can get them out with a full complement of formatting, printing and file conversion options (including Wordstar compatibility). From a two-page report to the Great American Novel, OUT-THINK will rotate your headers and footers with page numbers and give you a Table of Contents to boot.



OUT-THINK is brought to you by KAMASOFT. We pioneered outline processing and brought this amazing new technology to CP/M computers. For over 2 years, our KAMAS programmable outline processor has been widely acclaimed:

*"Outline processing might be the next wave in software, and KAMAS is a good place to start."*  
- Ezra Shapiro, BYTE

*"The outline processor is simple, easy to use, and will appeal to all users."*  
- Mark Renne, INFOWORLD

*"If you're a writer using a CP/M based system, get KAMAS. You'll love it. It's that simple."*  
- Marybeth Highton, FOGHORN

*"Considering the quality of the program itself, the documentation, and newsletter, it has to be rated an outstanding value."*  
- Thomas Tucker, PROFILES

Our new OUT-THINK is simpler and easier to use than KAMAS. Yet, it offers more printing and formatting options, better handling and control, and faster operations. And at \$49.95 your ideas have never had it so good. OUT-THINK is simply spectacular. Try it for 60 days. If you're not completely satisfied, return it for a full refund.

**If you create and organize text in the course of your work, you owe it to yourself to get OUT-THINK.\***

\*But for some people, enough is never enough. Some like the challenge; others need the power. For you, we have the KAMAS Combo Pack. You get OUT-THINK's ease of use coupled with the extra horsepower of the KAMAS programming environment. And both use the same outline files.

**Hurry!**  
\$49.95 Intro. Offer  
Ends 6/30/86.

Rush me my choice now:



**OUT-THINK**  
the simple and easy to use outline processor:

**special introductory \$49.95\***



**KAMAS**  
the programmable powerhouse:

**\$99.95\***



**KAMAS COMBO PACK**  
the power and the glory:

**\$129.95\***

\*Includes S/H U.S. & Canada. Overseas add: \$10 for OUT-THINK; \$30 for KAMAS or COMBO PACK.

KAMAS owners: Send us your master disk and \$25 for OUT-THINK.



☐ Payment Enclosed

Card No. Exp. Date

Signature

Name

Address

City State Zip

Telephone

Our software is available for most CP/M computers. Tell us about yours:

Computer Make/Model

Disk Size: ☐ 5 1/4" SSDD ☐ 5 1/4" DSDD ☐ 8" SSDD

Requirements: CP/M 2.2 or above (48K TPA). Minimum 200K of disk storage. 80 column x 24 line screen. (Note: KAMAS requires 56K TPA and Z80 processor.)

Terms: All orders prepaid. PO's accepted when accompanied by payment. Foreign checks must be drawn on US banks in US funds.

**MAIL ORDERS TO:**

**KAMASOFT™**

2525 SW 224th Ave.  
P.O. Box 5549  
Aloha, OR 97007

**CALL IN YOUR ORDER:  
503-649-3765**

Wordstar is a registered trademark of MicroPro, Inc. Z80 is a registered trademark of Zilog, Inc. CP/M is a registered trademark of Digital Research, Inc. KAMAS, KAMASOFT, and OUT-THINK are trademarks of KAMASOFT, Inc.  
© 1985 KAMASOFT, Inc.



By Laine Stump

Development Foundation of Turkey  
Tunali Hilmi Cad. 22  
Ankara Turkey

## Importing Systems From Taiwan, Part II

*If you enjoyed the article on doing your own importing in Issue 29 then you must read about Laine's travels through eastern Asia searching for new bargains and legitimate suppliers. This is the journey we'd all like to make.*

**S**o you want some justification for the "World" in 86 World, huh?

As I'm writing this sentence, our flight is just leveling off after takeoff from Hong Kong International Airport (I'm writing with my brand new toy, a Toshiba 1100 portable). We arrived in Hong Kong yesterday afternoon after spending a week in Tokyo attending Comdex-Japan and two weeks in Taipei talking to scores of computer suppliers and manufacturers and others who professed to be one or the other (or both) but were neither. But first some background...

### Why East Asia?

The company I'm working for has its main office in Ankara and approximately 30 field offices scattered all across Turkey. One of my jobs is to set up microcomputer systems to be used for accounting at the field offices. (We will eventually have at least 100 PCs, several network file servers, printers, and possibly other equipment.) Because of the sinful price and poor-to-nonexistent service offered by the local distributors of American and European equipment, we decided to go direct.

We had considered using Slicers with CCP/M and several terminals, but decided that a network of PCs would provide easier hardware expansion capabilities in the future, and using MS-DOS would give us a greater software base.

Since the cheapest PCs come from the Far East (Taiwan in particular), we counted that as our best bet, but figured we should check it out first

just to make sure of what we were getting ourselves into.

### Info And Samples

Last October I began compiling a list of names and addresses of Far East suppliers of PCs. We picked the 15 best prospects, sent them each a telex, and eventually ordered five samples — three complete units and two motherboards. Then we waited. (We're not lavished with 48-hour service like you sultans in the U.S.)

### You're Selling WHAT?!

In the meantime, we were still receiving product information from Taiwan:

*Please note that we are supplying cards which are copyrighted by some American companies. We are selling these cards at much lower prices but we shall not hold any responsibility in the event of claims by the original makers at your side. Please refer to "ADAPTORS WITH COPYRIGHT INFRINGEMENT" for pricing.*

Some of the items available (for \$10/pc without manual) are:

CCP/M 3.1, 3.2, 4.1; MS-DOS 2.0, 2.11, 3.0, 3.1; Sidekick; Turbo Pascal 1.0, 2.0, 3.0; Lotus 1-2-3; Auto-CAD 2.17B; Microsoft COBOL; Microsoft FORTRAN; Microsoft C; etc.

So they have a few things to learn about copyright laws. We can still surely find SOMEONE to supply us reliably, legally, and promptly. Can't we?

### Meanwhile The Hardware Shows Up

We finally got the machines and started playing. They definitely had problems.

We could tell even from our small sampling that quality control differed greatly from one company to the next. We could also tell that some companies were much more experienced in dealing with foreigners (and in dealing with computers). One company couldn't even figure out how to ship

air freight from Taipei to Ankara; we had to send them a telex with instructions!

From this experience we knew that the only way to find a good supplier (quality, reliability, and legality) was to go there ourselves and see the companies in person.

### The First Leg

When Ergun (coworker) and I arrived in Islamabad from Ankara, we discovered the flight to Peking wasn't until the next morning. So we got to spend the night sitting around a table in the restaurant at the airport talking to two Chinese meat cutters (horse meat, actually) who had been visiting relatives in Turkey. It turned out that their family had come from Turkestan in Western China, but several of them had fled to Turkey during the communist takeover. Now, after 30 years, they had been allowed to travel to Turkey for a reunion.

### Where Is Your Visa?

Islamabad is near the western end of the Himalayas so as soon as we took off we began circling to get up to 30,000 feet before we headed toward the "foothills." At first I was amazed by the size of the mountains and glaciers and the thousands of square miles of terrain they covered, but after about an hour of mountain after mountain I fell asleep.

We landed at the Peking (Beijing) airport for a one hour fueling stop and as soon as the "snorkel" was hooked up and the door was open, the cabin filled with young soldiers asking to look at everyone's passports. One of them looked at Ergun's, and gave it back, then took mine, looked through all the pages, looked through again, called over one of his friends and they both looked at every page. Then they asked, "Where is your transit visa?"

"What? I didn't know I needed one."



# STYLEWriter

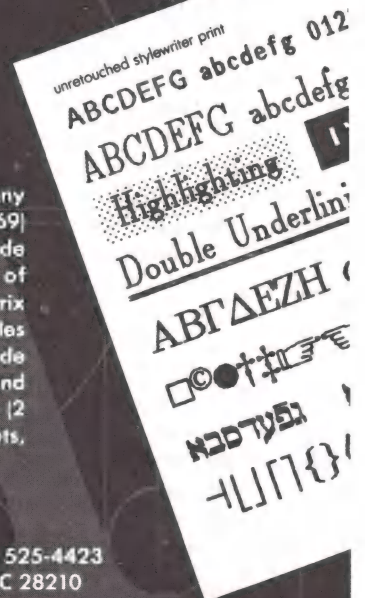
## The Buffer That Upgrades Your Printer\* To Letter Quality



StyleWriter buffers work with any software, any hardware and are available in 8K (\$139), 64K (\$169) and 128K (\$199) versions. An optional \$59 upgrade package gives StyleWriter the capability of converting any all points addressable dot matrix printer to letter quality allowing multiple type styles to be printed on the same document. Features include double underlining, highlighting, inverse printing and right justification. Over 100 type styles available (2 supplied with package) including foreign alphabets, scientific notation and oversized characters.



For more information call 1-800-222-9073, (704) 525-4423  
or write • CEL • 818 Tyvola Rd./109 • Charlotte, NC 28210



"Americans need a transit visa for traveling through China."

I was led down the hall into a series of rooms by a polite young man who kept smiling and saying, "You just get a visa now, no problem." I wasn't smiling; my mind was racing with thoughts of bamboo under my fingernails and meals of dried bean curd and fried locust eggs.

It ended up only costing me \$14, and I didn't even have to sign a confession of my guilt in the capitalist oppression of the world. After we took off again, one of the stewardesses told me that a few years before, a family of four Americans had been fined \$4000 for exactly the same thing. I guess the People's Republic is getting soft in its old age...

### Once Is Not Enough

Before we left Ankara, I had asked one of the secretaries at the office to check every country we were going to to see if I needed any visas. She came to my office later and said, "I checked and you don't need ANY visas for ANYwhere!" So, she had made one mistake — maybe it was just an oversight (and maybe boiled chicken feet really IS a good appetizer...)

In Tokyo my friend passed through immigration with no problem. Piece of cake, I thought to myself. I strutted up to the counter and handed my passport to the man behind the glass. He looked through all the pages. Then he looked through all the pages again. Finally came the question: "Where is your Japanese visa?"

My stomach sunk. "I didn't know I needed one." Same old story. "What must I do now?"

"Probably you must leave the country and get a visa, then come back again."

After some talking and giving names for references, hotel reservations, brochures of Comdex, and all that, finally I was granted special permission to

stay in Japan for two weeks. "But next time you get a Japanese visa before you come to Japan. And fly Japanese Air Lines."

### Tokyo And Comdex-Japan

Tokyo was quite a change from the Ankara scene I have become accustomed to in the last six months. Huge fluorescent light shows on all the buildings, clean streets, clean (relatively speaking) air, Mc Donald's all over town, a wonderful modern subway system, and drivers that actually stop for pedestrians.

We spent three days at Comdex. (Insidious, these Japanese.) In general we were slightly disappointed with the quantity and selection of items on display, but there were a few products that made the trip worthwhile.

### Citizen Lap-Tops

One thing I was hoping to see a lot of was lap-top portables (actually I was looking to buy one to use for the rest of the trip). But the only company that had a REAL portable on display (under 10 lbs., quad density 3.5" drive, no bigger than a small box of corn flakes) told me they couldn't sell it

unless I wanted to order 10,000 or so.

This company was Citizen (of watch making fame). They had two models at their booth, one looking amazingly like the Kaypro 2000 and another with a larger screen and two front loading, super-thin floppy drives. The one that looked like the 2000 actually WAS a 2000. It turns out that Citizen makes the entire 2000 unit for Kaypro, excluding the motherboard, for \$300 a copy.

### Little Flopsies

The products I found most interesting at Comdex were the 3.5" disk drives. All the drive companies were pushing these little buggers. Three inch drives have been available in the past, but only with capacities up to 1 megabyte. Well, Virginia, now you can store the entire data file for a high resolution color graphic image of Santa Claus (and all his reindeer) (in several attractive poses) on a single 3.5" floppy. Almost everybody at Comdex had models that would store 1.6 Megs (unformatted), and Teac even had a prototype for a model that would do 2 Megs!

(continued next page)



(continued from page 37)

The 1.6 Meg units are IBM-AT compatible and are just entering mass production now; the 2 Meg Teac won't go into production until they get a sizeable request from a large OEM. Most manufacturers are selling their 3.5" drives for about the same price as the 5" equivalents. IBM's new Japanese model (the JX) is using 1 Meg 3.5" drives, and I keep hearing that all of IBM's new machines are going to use them, so look for these fellas to take over a considerable share of the market in the next four or five months.

### Skinny Flopsies

The other interesting development in tiny drives was the new trend in "super thin" models. These little jewels are almost exactly half the height of a half-height drive, so I guess that makes them quarter-height (can't you just see the ads now? "ALL NEW! Quarter-height, quad density, double sided, half power, double track, half wit drives!"). Most companies seemed content with squeezing down only 3.5" models, but Canon had 5" models as well. It doesn't look like 5" drives will be used on new models much longer, but I suppose the super-thins can be used for replacements in existing equipment.

### Thin Displays

Floppies weren't the only thin things at Comdex. Thin screens were "in" too. Along with the normal ho-hum LCD screens were a few examples of the new (and expensive) plasma displays and a new backlit LCD screen. The plasma displays are still too expensive and use too much power (although the display quality is heavenly), but the backlit LCD (shown by Citizen) is quite interesting.

Normal LCDs have a black backdrop and when the crystal at a certain spot is rotated, the black shows through. This works, of course, only if there is sufficient light to reflect off the unrotated crystals but not enough to reflect off the black.

The backlit LCD works a bit differently however. Unrotated crystals appear black, while the backdrop is an evenly distributed internal light

source. "Unrotated" is now black and "rotated" is white. Because the light source is always even and always from the same angle, the display remains visible under much more adverse conditions than a traditional LCD display.

Backlit LCDs will probably cost a bit more (but not much) than the normal screens for awhile and they may use just a touch more power, but I would still buy one tomorrow.

### Legal BIOS

One company at Comdex was selling a legal BIOS for AT compatibles. Since the Taiwanese are having a tough time getting IBM original software through customs, and Phoenix and the other established companies (even ERSO) are charging outrageous fees (I heard someone mention \$200,000 for a limited license), a New Jersey company has decided to market its own AT BIOS in the Orient. They were talking about \$30,000 for an UNLIMITED license (you can make as many copies as you want).

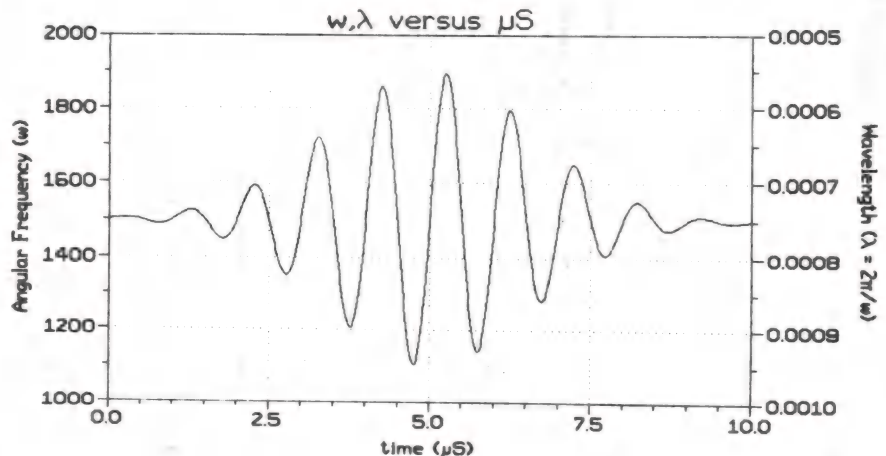
The company's name was AMI, and it had several other products to sell to OEMs, mostly software and designs for hardware based on the 8088-80386 processors.

It's a great idea, designing something and then selling the design so you don't have to worry about all the overhead of starting up a factory, but I can see one problem that AMI will have, especially in Taiwan. The problem is that software and hardware designs are intangibles. Most Taiwanese companies we talked to could not quite grasp the idea that intangibles had value; the price of a piece of software should be the price of the media (disk or ROM chip) plus the cost of the labor required to duplicate it. Right?

### Who's Who At Comdex

One thing that both Ergun and I noticed throughout the entire exhibition was that everybody who was selling peripherals or software used either IBM original equipment or NEC

## GRAPHICS

starting at \$49<sup>95</sup>

**SCI-GRAF:** Produces line, scatter, and high/low plots on Epson or IBM compatible dot-matrix graphics printers. Supports images up to 1680x1712 dots (over 3 million pixels!), log & linear scales, graphs in 7 colors (on a JX-80), batch processing. Requires MS-DOS 2 or 3, 256k ... \$99<sup>95</sup>

**FONTEDIT:** Easy-to-use full screen font editor allows you to create and modify fonts for our SCI-GRAF program. Create Greek, math, and custom symbols in 3 sizes. Supports SCI-GRAF's proportional spacing. Requires IBM compatible 320x200 pixel on-screen graphics & IBM compatible keyboard ... \$39<sup>95</sup>

**GRAF 3.0:** Produces bar, pie, line, scatter, and high/low plots on Epson, IBM, C.Itoh, or NEC compatible dot-matrix graphics printers. Supports 14 fill-in patterns, 8 point-plotting symbols, automatic scaling, labeling, and legend creation. MS-DOS 2 or 3, 192k ... \$69<sup>95</sup>  
CP/M-80: Requires 64k (54k TPA) \$49<sup>95</sup>

**MSC** Microcomputer Systems Consultants

27 Forest Avenue Port Jefferson Station New York 11776-1820 (516) 928-7493



9801 PCs. The 9801 is NOT a compatible; it is so much better than the IBM that the blue suits should hang their heads in shame. The most notable feature is the system's graphics — resolution of something like 900 x 700 in color mode!

Something very obvious in Japan was that most companies are not so uptight about being IBM compatible (for domestic units) as manufacturers in other countries. One person told me, "We would rather have higher resolution graphics and faster processing." I'm glad SOMEBODY doesn't feel the need to follow along with the "crowd."

#### MPZ 2060

One of the Japanese companies we'd hoped to see at Comdex was Micro Research. MR's main product currently is a multiuser supermicro called the MPZ 2060. It uses an 80286 processor running at 8 or 10MHz coupled with several 80186 co-processors handling the I/O. It comes standard with 3 Meg

of RAM, a 140 Meg 8" winchester, and Xenix V version 3.2. Expansion cards are connected via a multibus.

In most cases I would just laugh at someone who claimed that their 286 system could handle 16 users. I was skeptical this time too, until I found out about the I/O co-processors. I'm still doubtful about connecting 16 users, but I think the MPZ 2060 would do just great for about six or eight heavy hackers, and even more if some of the terminals spend most of their time twiddling their diodes waiting for the lackey at the desk to type something.

#### General Impression Of Japan

Overall, I must say that the Japanese companies we dealt with were very formal, full of rules, no nonsense. "If we must then let's do business and get it over with." Most everyone wanted a complete history of our company along with our current economic status and our projected sales for the next five years before they

would even CONSIDER doing business with us.

#### On To Taiwan

We had met with varying degrees of success/failure with the sample units we ordered from Taiwan. Some had arrived within a few weeks, some took nearly two months, some worked, some didn't. When we arrived in Taiwan, we planned to see a lot of companies and expected to find a few good ones and a LOT of bad ones. We weren't disappointed.

#### Colonel Cheng's Taiwanese Fried PCs

The first "computer company" we ran across was run by a friend of a friend of our boss. His company actually dealt mainly in chickens and chicken feed. We had been told to contact him for help in getting around in Taipei, but he had somehow gotten wind of the fact we were coming and that we were looking for computers.

(continued next page)

LEAP INTO A NEW DIMENSION



Full implementation of "C" with standard floating point, library, and I/O subroutines. UNIX VER 7 compatible. Produces relocatable 8080 (optional 0280) assembler code. Relocating assembler and linker supplied with package or use Microsoft M80 and L80, SID/ZSID debugger interface. FAST COMPILATION AND EXECUTION.

**AZTEC CII FOR CP/M \$199**  
(Special price for Micro C subscribers \$149)



**MANX**  
software systems

Box 55, Shrewsbury, N.J. 07701  
(201) 780-4004



Also available for Apple DOS, HDOS, CP/M-86, PC-DOS

**THE PROVEN  
MICRO FAMILY**  
for all the  
**INDUSTRY  
APPLICATIONS**

**SLICER®**

**\*Specials**

**New Low Prices!**

- \*Multi-User Slicer Combo ..... \$950.00  
Slicer SBC A&T (No RAM)  
Slicer 1 MEG Board A&T (Complete)  
CCP/M by Digital Research Inc.
  - Slicer SBC A&T 256K ..... \$445.00
  - \*Slicer SBC A&T 128K ..... \$350.00  
with double deck sockets for additional 128K
  - \*Slicer SBC A&T (No RAM) ..... \$295.00
  - \*Slicer 1 MEG Board A&T ..... \$450.00
  - \*Slicer 1 MEG Board (Full Kit) ..... \$295.00
  - Slicer PC Expansion Board A&T ..... \$495.00
  - CCP/M (Digital Research Inc.) ..... \$250.00
  - MS DOS (Micro-Soft Corp.) ..... \$175.00
  - \*New Slicer Bios for MS DOS ..... Call
- Other kit forms available - Enclosures & other support hardware in stock - Call or write for latest information & prices!

**SLICER COMPUTERS INC.**

2543 Marshall Street N.E.  
Minneapolis, MN 55418

(612) 788-9481  
BBS (612) 788-5909



(continued from page 39)

We called him up from the hotel and he sent a car to get us. When we got to his office, our chicken dealer suddenly became a computer manufacturer. He took us into the next room so that his assistant could give us a test run of the demonstration unit (obviously set up just for us) and we were swept off our feet by the sounds of "Sakura" played by the IBM diagnostics program.

We were deeply moved by the performance but had to throw aside our initial infatuation and force ourselves to leave the building without confirming an order for a thousand units.

### How To Meet Companies

Within a day after we arrived in Taipei, before we had talked to anyone except the people at the airport and the hotel, we began getting phone calls.

One of the first persons to be granted an audience with us was an agent for a shipping company. When we asked him how everybody knew our names he showed us a little newsletter that was full of names, including ours. Someone at the airport got the scoop on us from the immigration office and now so did the whole city of Taipei. They knew who we were, where we were from, what we were buying, where we were staying, and probably even our favorite drink.

In other words, in Taiwan, you don't have to find sources; all you have to do is walk off the plane, put "looking for computers" on your immigration form, and make sure you get a motel reservation from the counter at the airport. They'll find you. Of course you may not find the best company that way. We felt that our approach was best; we arrived in Taipei with lots of names, prices, and information. That way if somebody was feeding us a line, we would know.

Our best source of company names was Asian Sources Magazine. Figure 1 gives a list of the few best we found; the worst aren't even worth the cost of the paper to print a list.

By the way, after the third day, the plethora of calls at all hours of the day and night forced us to move to a

different hotel leaving no forwarding address.

### We Make SPECIAL Deal For You

Every company seemed to think that it had some unique selling point. They all claimed that they had designed their own hardware, written their own software, and had their own factory "just outside of town." But after a couple of days I began noticing that all the monochrome cards had the same layout, the same manual printed at the same shop, and were packaged in the same box.

### The Structure

In reality, almost all of the circuit boards coming from Taiwan are manufactured at one of five or six PC board factories and distributed to "sweat shops" for hand insertion of the ICs.

The ICs, by the way, are sold in packages; for instance a "motherboard chip set" is purchased as a unit from a chip set company and includes all chips necessary for a complete XT motherboard. The companies inserting the ICs have no idea WHY the boards work; they follow the diagram that tells them to put chip D in slot 5 (and light a stick of incense).

After the chips are inserted on the board, the boards are usually run across a small wave-soldering machine, although the smallest companies do their soldering by hand. After the parts are glued into place, there may or may not be testing. If there's testing it's usually the Pacman variety (if the ghosts move then the incense worked).

You may be dealing with a company at any one of these levels. If you happen to find the right one, you will purchase the boards directly from the people who insert the chips (I decline to call them manufacturers). Most of

the computer companies in Taipei are really just trading companies.

Many times a trading company will claim to be the manufacturer. We were even given a tour of "my factory" by a man who ran a trading company. "Later I take you to see my friend who makes Rolex watches. He give you SPECIAL deal! Less than \$30!" You can imagine the support you'd get from one of these companies. So if you're going to buy from Taiwan then you'd better have some schematics and know what's going on, or you're going to learn real quick.

### Hardware Prices

Prices varied. Different price didn't necessarily mean different quality, though. The most expensive boards were from Multitech, the largest, most reputable computer company in Taiwan. Multitech was charging about \$200-\$300 more for a complete system (with 20 Meg winchester) than the lowest prices.

The lowest prices were from the chip inserters. Somewhere in the middle were the trading companies. Most trading companies were not a good deal. They offered no extra services for their cut, although one of them, Aquarius Systems, was a decent outfit.

Aquarius Systems specialized in assembling boards from other companies and TESTING them before shipping. One of their systems was based on the Multitech 700 Turbo motherboard, and Aquarius was selling it with one floppy for about \$150-\$200 less than Multitech.

Prices change from day to day, but Figure 2 shows the lowest quotes we got for quantity 100, given by Auto Computer Company, the largest and lowest priced chip inserter we visited. Note that these prices are FOB Taipei for quantity 100.

Figure 2 - Prices From Taiwanese Companies

|   |         |
|---|---------|
| Turbo (8MHz) motherboard 640K, w/OK installed         | \$79.00 |
| Floppy controller card, 4 drives                      | \$18.50 |
| Hercules mono-graphic card w/printer port             | \$42.00 |
| Switching Power Supply, 135 watt                      | \$42.00 |
| Keyboard, AT layout, Cherry keyswitches               | \$33.00 |
| XT flip-top metal cabinet                             | \$17.00 |
| Monochrome monitor, 12" (Cheer brand, CHEEP)          | \$55.00 |
| (Editor's note: I have a "Cheer" and it's just fine.) |         |



If you hunt you can find better prices (for instance \$51 for 12 inch monitors from Lucky Gold Star in Korea), but it's nice to have to worry about only one LC (Letter of Credit) and one shipment. Definitely shop around. Price, service, and ability to communicate are what counts; design quality won't change at all (and workmanship will change little) from company to company.

#### Disk Drives

Disk drives are quite expensive in Taiwan, especially winchesters. Purchase these from Japan, the U.S., and Singapore. Floppies are another matter. A \$75 Japanese 5" DD drive cost \$50 or \$60 when manufactured in Taiwan. The best price we found for 3.5" 1 Meg drives was \$85 from Toshiba in Hong Kong where I bought my T1100. But Ho Shin of Taiwan is planning to start production of their own 3.5" 1 Meggers for about \$60 each.

#### Is There A REAL Legal BIOS?

Now for the software. You've probably heard lots of rumors about software piracy in Asia. Well, I have to tell you that none of it is exaggerated even a little bit. We must have seen at least 20 retail shops selling everything from AutoCAD to Xenix for \$5 per disk.

That didn't really bother me though, after I thought about it. A few guys selling a few copies of CCP/M to poor Taiwanese students who wouldn't have bought if they had to pay retail anyway can't do much harm.

What bothered me was the 10 or so companies who were selling copyrighted software to their distributors and dealers all over the world, perpetrating the software to such depths that nobody may ever sell another software product again.

#### Government Actions

The U.S. government says it's taken action, and apparently it's been enough to put a scare in most of the computer companies in Taiwan. They have no qualms about shipping any BIOS, legal or illegal, to any country, EXCEPT the U.S.

(continued next page)

Figure 1 - A Short List Of "Good" Companies

|  |  |
|--|--|
| Bison International Co. Ltd.<br>P.O. Box 8-231<br>Taipei, TAIWAN R.O.C.                          | Prices nearly as good as Auto C.<br>BIOS is "in house" & will be approved.<br>MSDOS not available.   |
| No. 16, Sec. 1 Chung-Shan N. Rd.<br>Taipei, TAIWAN, R.O.C.                                       | Turbo board with V20 original equipment.   |
| tel: 381-9171<br>fax: 381-3175<br>tlx: 11291 MULTIFOT  | Actually engineers working!!!  |
| *****  |  |
| Auto Computer Co. Ltd.<br><br>3F, No. 27-1, Sec. 3,<br>Roosevelt Rd.,<br>Taipei, TAIWAN R.O.C    | Best prices<br>Can provide legal BIOS<br><br>Possibly MSDOS, but<br>check it out thoroughly  |
| tel: (02) 393-4568-9<br>tlx: 11888 APEXLEEC  | No engineers, but<br>incredibly high volume.   |
| *****  |  |
| Aquarius Systems<br>6F, No. 394 Keelung Rd., Sec. 1<br>Taipei, TAIWAN R.O.C.                     | Trading company, but good.<br>Manager speaks GOOD English.<br>500 series uses Multitech mboard<br>(and includes licensed MSDOS and<br>BIOS)(Multitech insists) |
| P.O. Box 48-29<br><br>tel:(02)706-9140<br>tlx:13138 AQUUSYS                                      |  |
| *****  |  |
| Prestico Associated Corp.<br>9F, 41-2 Shin-Yi Rd., Sec. 3<br>Taipei, TAIWAN R.O.C.               | Not best prices, but a nice guy.<br>Trading company  |
| P.O. Box 7-559<br><br>tel:(02) 709-4541<br>tlx:23561 PRESCIAR                                    |  |
| *****  |  |
| Ho-Shin Subsystem Co. Ltd.<br>3-5, Lane 145,<br>Hsin Sheng S. Rd., Sec. 1<br>Taipei 10626 TAIWAN | Floppy drive manufacturer<br><br>5" AT & 3.5" soon<br>\$65-70 per piece in 200s  |
| tel: (02)701-3583<br>tlx: 25525 JOEYPENG   |  |
| *****  |  |
| FROM "IN JAPAN" Section:   |  |
| AMI (Access Methods Incorporated)<br>590 Valley Road<br>Upper Montclair<br>New Jersey 07043      | AT BIOS, AT hardware design<br>EGA compatible graphics board<br>80386 designs<br>Interesting new company   |
| tel: (201) 744-9126  |  |



# ED/ASM-86

*The first truly integrated Editor, Assembler, Debugger, and Linker is now available from Oliver Computing Company.*

\* The Editor supports block move, block copy, partial save and partial load insertion. All text is tokenized for both efficiency of storage and very fast assembly time. FAST screen I/O and separate editor/debug windows.

\* The Assembler can be immediately invoked after any editing command. Output can be directed into memory, to a .COM file, .EXE, or to ED/ASM-86's own efficient .LNK file format. 8087/186/286 instructions supported. Macros and most standard pseudo-ops are supported.

UNIQUE to ED/ASM is its structured assembly language capability. No more wasted labels and time! Multiple segmented programs can be sent to .COM files.

\* The built in debugger supports symbolic disassembly, integration with the assembler, as well as disassembly of 8087/186/286 instructions. Display 8087 registers in scientific decimal format. SPLIT SCREEN debugging with a dynamic register window is easily invoked. Disassemble programs to disk file for easier analysis. "Single-step" data editing supported for bytes, words, double words, and 8087 floating constants in memory. You can "patch" assemble a line at a time with symbols from previous assembly (even define symbols as you go!)

\* The linker supports ED/ASM-86 link files, which can be created from virtually any valid ED/ASM-86 source file, even lines with multiple external symbols in expressions. (Note: not compatible with usual link format)

\* And many more features too extensive to be listed here.

All of these features exist in one integrated program. A typical development cycle with ED/ASM-86 consists of entering a program with the editor, or editing an existing program, typing "A;-IM" to assemble into memory, going into the debugger to immediately test the program. Then you go back to the editor for the next cycle.

ED/ASM was developed for Oliver Computing's own use, and has been used for over a year to enhance itself!

ED/ASM-86 is only \$95. Send check or M.O. to:  
Oliver Computing Company, P.O. Box 90140, Indianapolis, IN 46290 { (317) 849-4450 }  
for immediate delivery via UPS.

## 86 WORLD

(continued from page 41)

The Taiwanese government also has addressed the situation by prosecuting people who copy IBM software. An example might help to illustrate the point.

While talking to all the companies, I got into the habit of asking them whether their BIOS was legal or not and who the source was. At one company I was told, "Yes, it's legal."

Then I asked, "Does that mean that, for example, I could take this BIOS through U.S. Customs and it would pass?"

"Oh, no. You can't do that."

"Then it's NOT legal."

"Oh, yes, it's legal. You just can't take it through U.S. Customs. We might get in trouble."

That confused me a little until I talked with another company:

"Our BIOS has no copyright problems at all."

"Did you develop it, or are you licensing someone else's?"

"Oh, we copied it from UITRA."

"Then it's illegal."

"No, no copyright problems. It's not IBM original. If it was IBM original then we wouldn't be able to send it on the board, but since it's not IBM, Taiwanese Customs doesn't mind. Do you want IBM original? We can supply

it, but we will have to send it air mail separate from the rest of the system. They don't check there."

So, "legal" actually means "not IBM." And "copyrighted" means "somebody copyrighted it." So beware when you are told "our BIOS is copyrighted." It still could be stolen.

### BIOS Source

By the way, Gary mentioned ERSO in issue 29. The story he gives isn't exactly the whole story. ERSO (Electronic Research and Something Organization) was actually put together some time ago to help all electronics oriented companies. Currently their work involves mostly computer companies, and they design disk drives and other things.

On the outside, ERSO looks like a public service organization, but they've gone commercial. Many Taiwanese companies are not purchasing the ERSO BIOS because they say it's too expensive. Instead, they're getting a license from someone else or just copying it.

There are at least eight different BIOSes floating around in Taiwan — IBS, UITRA, Super Computer, Mega XT, ERSO, ARC, Phoenix, and of course, IBM. Many of these are just copies of one another; but they're changed enough to be legal.

Speaking of changing to be legal,

that's what ERSO apparently did. When IBM got mad and started hunting for pirates, one of their first victims was ERSO. So ERSO modified the old BIOS so it wasn't quite compatible (i.e., some things don't work). That's what I heard, anyway.

### MS-DOS

If you're looking for a legal MS-DOS license in Taiwan, forget it, unless you're dealing with Multitech (and possibly Aquarius). It just don't exist. Well, it does in some places, but it's difficult to tell who is selling you a license and who is selling just a disk. It's all the same to them. Best bet would be to buy the boards without MS-DOS and buy PC-DOS. It's a bit more expensive (licenses coming with equipment can be as low as \$15), but it's safer.

That's it for now. Allahasmarladik (ciao, baby). Pray for sun at SOG.

Editor's notes: Laine is trying to make it to SOG V. If he does, SOG attendees will get a look at the guts of the international trade and copyright business — and Turkish computer technology — that will blow their turbans off.

Also, I published an old address for the import broker I mentioned in Issue 29. The real address is: Newman Wilson Co  
7212 NE Airport Way  
Portland OR 97218





# EXPANDING YOUR KAYPRO AND XEROX JUST GOT CHEAPER!

## CHECK OUT OUR \*\*\* SOG SPECIALS \*\*\*

*Most versatile. Easiest to use. Finest quality. Claims are one thing, but the proof is in our products. We guarantee satisfaction.*

**Nothing can improve your computer's productivity like a hard disk.**

### HARD DISK SYSTEMS by Emerald Microware

If you have been thinking about moving up to a hard drive, why wait any longer? We have everything you need from the host board to a complete turn-key system. Runs on the Xerox, Kaypro, or almost ANY Z80 system.

**HDS Host Board** — The hardware you need to connect your computer to your hard disk controller board.

- Interfaces to the WD1002 controller board
- Plugs into the Z80 socket, no other wiring required
- Switch selectable I/O addressing
- Comes fully assembled and tested

### THE WINCHESTER CONNECTION by MICROCode Consulting

The most comprehensive hard disk software package that you can buy.

- Works with one or two hard disks — 5 to 64 meg
- Menu operated install, no software to assemble
- Complete testing and error handling
- Warm boot from hard drive
- BIOS drivers install above or below CP/M, your option
- Allows custom partitioning and mixed drives types
- Includes manual, format, test, park, backup, and swap utilities

### WD1002-05 HARD DISK CONTROLLER BOARD by Western Digital

- 5 1/4" profile with standard power connector (+5 only required)
- 40 pin host interface
- Connects to ST506 compatible drives
- WD2797 floppy disk controller and interface on board
- Can control up to three hard drives and four 5 1/4" floppies

### COMPLETE HARD DISK SUBSYSTEMS by Emerald Microware

- Hard disk subsystems with host, cables, software, hard drive, and cabinets with power supply. Fully tested and ready to go.
- Internal hard disk kits available for Kaypro computers
- 10 and 20 meg units in stock, others by order
- Available for Kaypro, Xerox, Morrow, and others

|  |                  |
|--|------------------|
| 10 Meg Hard Drive Subsystem              | *** \$725.00 *** |
| 20 Meg Hard Drive Subsystem              | *** \$895.00 *** |
| Host board with software                 | \$ 89.00         |
| WD1002-05 Controller Board               | \$185.00         |
| 20 Meg Kaypro Internal kit w/KayPLUS rom | \$995.00         |

### ACCESSORIES FOR THE KAYPRO AND THE XEROX 820

|   |                  |
|---|------------------|
| Xerox 820-2 Main Computer Board   | *** \$ 75.00 *** |
| Xerox 820-2 Floppy Controller board   | \$ 75.00         |
| Xerox 820-2 Main board w/Floppy Controller                                  | *** \$125.00 *** |
| Xerox 5 1/4" Drive cabinet w/cable  | \$ 25.00         |
| Xerox internal video cable  | \$ 8.00          |
| Board mount power connector   | \$ 2.50          |
| Parallel ASCII keyboard (not standard Xerox)                                | *** \$ 15.00 *** |
| Dual 5 1/4" Disk Drives — DSDD 48 TPI, in cabinet with standard Xerox cable | \$265.00         |
| Panasonic DSDD 48 TPI Disk Drives   | \$114.00         |
| Panasonic DSQD 96 TPI Disk Drives   | \$129.00         |

\*\*\* SOG Special prices good through August 31, 1986 \*\*\*

We guarantee satisfaction on all of our products or your money back. Include \$4.00 shipping and handling, \$7.00 for COD, call for Blue Label charges. Phone hours: 8:30am to 5:00 pm weekdays; check our bulletin board — RQP/M, 5:30pm to 8:00am seven days a week, for our latest stock and prices.



WE SUPPORT OUR CUSTOMERS



### INTRODUCING THE KayPLUS ROM PACKAGE by MICROCode Consulting

The most important element in the performance of your Kaypro computer is its monitor rom. With **KayPLUS** you get all of the advantages of a Kaypro 10, even on your Kaypro 2.

- Install up to four floppies and two hard drives
- Boots from floppy or hard disk
- 32 character keyboard buffer
- Automatic screen blanking
- 12 disk formats built in
- Full automatic disk relogging
- Internal real-time clock and ram card support
- Can use 96 TPI and 3 1/2" disk drives
- Includes manual, format, configuration, diagnostics, sysgen, and hard disk utilities
- No software assembly required
- Available for '83 and '84 series Kaypros

|                           |                  |
|---------------------------|------------------|
| KayPLUS ROM Set           | \$ 69.95         |
| KayPLUS ROM Set with QP/M | *** \$125.00 *** |

### Need to keep better track of your files?

**Date stamp them with QP/M.**

### QP/M by MICROCode Consulting

Full CP/M 2.2 compatability with many more features. You've seen the replacements that eat up memory and need auxillary programs to run. Not QP/M. Fifteen internal commands, automatic disk relogging (no more control C), user area selection from colon, 31 user areas, drive search path, archive bit maintenance, and transparent time/date stamping, all in the same space as CP/M 2.2. Installs from a convenient customization menu, without any software to assemble.

|   |          |
|---|----------|
| QP/M Operating System, complete bootable copy | \$ 80.00 |
| QP/M without BIOS                             | \$ 60.00 |

### Still running single density on your 820-1?

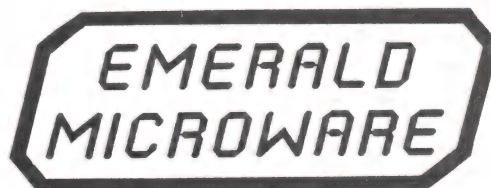
### PLUS2 ROM by MICROCode Consulting

### X120 DOUBLE DENSITY BOARD by Emerald Microware

Clearly the most versatile double density package for the Xerox 820-1. Run up to four floppy disk drives at once, both 8" and 5 1/4" at the same time. Software compatible with Kaypro and Xerox 820. Supports all standard printers, and most add ons like the Ferguson Ram Board. You get mini-monitor functions, autoboot capability, 19 built in disk formats, and bank mode operation for more space in your TPA. Lets you run 48 TPI disks on 96 track drives. Works with Uniform and QP/M.

|                                   |                   |
|-----------------------------------|-------------------|
| PLUS2 ROM Set and X120 Board A&T  | *** \$ 135.00 *** |
| PLUS2 ROM Set and X120 Bare Board | *** \$ 62.00 ***  |
| PLUS2 ROM Set only                | \$ 49.95          |
| 120 Bare Board only               | *** \$ 22.00 ***  |

Other kits, parts, and packages available



P.O. Box 6118

Aloha, OR 97007

(503) 642-1860



## 256K RAM Upgrade For 83 Kaypros

By Dr. Michael W.D. Liddle

21 The Frostings  
Grenoside  
Sheffield, S30 3NZ England

*I've received numerous requests from those of you who have wanted to build a RAM disk into your 83 Kaypro. My stock answer was that this kind of project didn't lend itself to homebuilding since RAM chips are so sensitive to noise on the supply and signal lines.*

*However, the good doctor has elegantly solved that problem by installing 256K chips in place of the original 64s. I wish you all much luck and little static while doing this fine project.*

An article in the September 1985 issue of Byte describing a 256K upgrade for the Atari 800XL prompted me to try a similar hardware hack on my pre-84 Kaypro 4.

Although I encountered a number of problems I now have a Kaypro with 256K RAM. The resulting improvement in performance has far surpassed my expectations.

Perfect Writer can now handle large files without protracted bouts of swapping and missing keyboard input. IN-FOCOM games run in erie silence with no disk drive motor noise and respond almost instantly. And I've even buffered my CCP and BDOS so that a warm boot is twice as fast.

The 256K RAM in my machine has been working perfectly for around six months now.

### Danger Down Under

This wasn't the first time I'd taken the lid off my Kaypro and delved inside. Within a year of buying it, I'd speeded the CPU up to 5MHz, added a ProMonitor 8 ROM, installed a ZTIME-1 clock board, and fitted it with twin Mitsubishi quad drives.

However, fitting 256K RAM chips with address decoding, bank switching, and refresh was certainly the most frightening upgrade I've ever per-

formed, since I was breaking new ground (for me) rather than following a proven design. As a result I learned a lot, some of it the hard way.

In the hope that I can spare others some of the worry and stress I suffered, here is a step by step guide on how to turn a Kaypro into a Kaypro 8-256.

### Kaypro 2 Or 4?

Although the case of my Kaypro proclaims it to be a II, it has a Kaypro 4 motherboard, as I discovered when my first Micro C ProMonitor ROM didn't work (they exchanged it for the correct one straight away and explained what had happened).

The circuit in Figure 1 should work with most Z80 machines that use 64K dynamic RAMs. However, the connections shown in Table 1 are obviously specific to the Kaypro 4 motherboard. If you have a different Kaypro model you may need to consult a schematic to locate specific signals.

This modification does involve fairly extensive surgery and an understanding of dynamic RAMs, so if you're not confident you can carry it out, get a friend who knows what he's doing to help (i.e., supervise).

Most of you are aware of the potential for static damage to ICs. And if you're like me, you may have become a little blasé about warnings. But be warned — 256K chips are among the most sensitive and easily damaged ICs you're likely to encounter.

If you want a reliable system and don't like wasting money take full precautions. I bought my chips from Microprocessors Unlimited, who provided good instructions for handling ICs. They also have low prices and high quality parts.

### The Mod

After unplugging your machine and removing the lid and the motherboard, carefully unsolder the eight 64K RAM

Table 1 - Connections Between Add-On Board and Main Processor

| Signal On New Board | Connection on 83 main board |
|---------------------|-----------------------------|
| REFRESH             | U48 pin 12                  |
| MUX                 | U33 pin 1                   |
| A14                 | U33 pin 11                  |
| A15                 | U33 pin 10                  |
| RA7*                | U20 pin 9                   |
| RA8*                | U20 pin 1                   |
| PIO 1               | Pad E29                     |
| PIO 2               | Pad E28                     |
| PIO 3               | Pad E31                     |

\*Outputs from new board

Note: Only 83 Kaypros have spare PIO control bits. 84 series would need additional latch & latch port decoding.

chips. (If they're in sockets, you probably shouldn't unsolder them.)

Unsoldering will take several hours and must be done delicately. Don't use too much heat; don't use more than minimal force; and don't rush. Use proper tools. A solder sucker and proper iron are essential. (Editor's note: The easiest way to remove 16-pin ICs is to cut the pins off the body first and then heat and remove them one by one.)

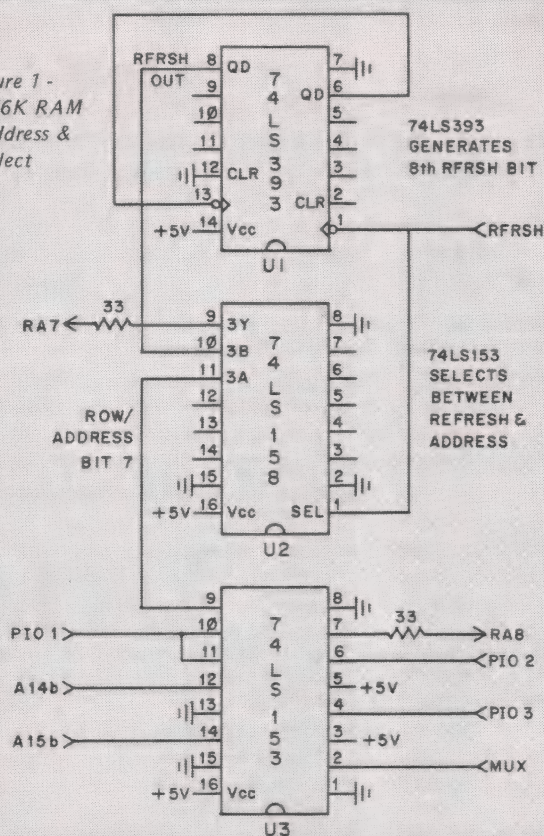
Whenever you make any modifications to a circuit you should proceed stepwise and test at each stage as a matter of routine. So having removed the chips, check the board carefully for damage.

Then install eight 16-pin sockets in place of the RAM chips, and plug 64K RAM chips into them (you could plug in the originals here if you didn't cut off the leads but you might be smarter to have a new set of eight 64's for this step). Check that they're the right way up and that no pins are bent out or folded under. After checking a second time, switch on and all should work as it did before.

Run your stiffest memory tests. If all isn't fine, check that the chips are in correctly, that solder joints are good,



Figure 1 -  
256K RAM  
Address &  
Select



and that no bridges of solder are shorting out tracks. Also make sure that no tracks have been damaged, and try again.

Finally, if it still doesn't work, try swapping in a set of 64K RAMs that work in another machine. Don't proceed further until your machine works correctly.

If all is working, disconnect again and wire all the pin 1s of the RAM sockets together under the board. On my Kaypro these are not connected to anything; make sure that the same is true on yours.

If your board has pin 1 of the RAM chips connected to ground, +5V, or anything else, then bend pin 1 out and wire the pin 1s of each chip together (when you plug in the 256K chips). Anyway, this is RA8, the 8th address line to the 256K RAM chips.

Now remove resistor R9 so that the RA7 signal is no longer connected to the address line multiplexer U33.

Make the circuit shown in Figure 1 on prototyping board. (Radio Shack sells suitable boards.) Connect the circuit to your Kaypro motherboard according to the wiring instructions in Table 1. Don't forget ground and +5V, and don't get them turned

around (I did the first time).

Now power up your motherboard (the 64K RAM is still in place). Everything should work as before. Run your stiffest hardware test programs. Use your machine extensively. When you're happy that all works as it should, replace the 64K chips with 256K chips. Test your machine again. If it works, you now have a Kaypro 8-256!

The circuit is similar to that in the September Byte and I advise you to get and read it first.

U1 is a twin 4-bit binary counter, and these are wired together as a divide by 64.

The refresh signal is fed through this to produce the eighth bit of the refresh address for the RAM chips.

Although the Z80 has an 8-bit refresh register, it only provides a 7-bit refresh address. U3 is a twin 4 line to 1 multiplexer.

This carries out bank switching to produce the new RA7 and RA8 for the RAM. It also ensures that the same bank is selected whenever an access is made to the top 32K of RAM. U2 combines RA7 with the refresh address generated by U3 producing the new RA7.

## Need your Kaypro™ at home and at work?

Let UniForm and UniDOS help you cut down on the carrying.

### UniForm by MicroSolutions

**Don't carry your computer, just take the diskette.**

The solution to the diskette and computer incompatibility problem. UniForm allows you to transfer diskette files between almost two hundred formats including CP/M, TRSDOS, and MSDOS. Lists computers by name—so you don't have to be a technical expert to use it. Read, write, and format diskettes for the target computer, even on 96 TPI drives.

UniForm is available from our stock for the Kaypro, Xerox 820-2, Morrow MD2 & MD3, IBM, and 100% compatibles.

UniForm ..... \$ 64.95

### UniDOS by MicroSolutions

**Turn your IBM into a Kaypro™.**

UniDOS allows you to actually RUN most of your CP/M programs on your IBM compatible, almost as fast as on their native system. Use UniDOS in conjunction with UniForm and you don't even need to copy your files, just run them as they are, right on your Kaypro™ diskette. 8080 code programs run using the NEC V20 chip which replaces your 8088. Z80 programs may be run in emulation mode. The V20 chip speeds up many standard DOS operations as well as maintaining 100% compatibility with your existing DOS programs.

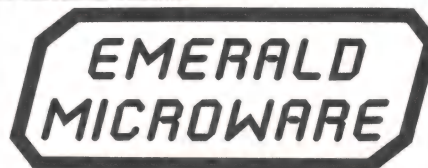
UniDOS emulates eleven computers or terminals including the Kaypro, Osborne, Northstar Advantage, and Apple Softcard CP/M.

UniDOS is available for IBM and 100% compatibles.

UniDOS ..... \$ 64.95

UniDOS and UniForm with V20 chip ..... \*\*\* \$139.95 \*\*\*

See our full page ad for our other products. Add \$4.00 for shipping and handling, \$7.00 for COD. Bankcards welcome.



P.O. BOX 6118

ALOHA, OR 97007

(503) 642-1860

### Software

Your Kaypro will behave no differently until you install software which uses the extra memory.

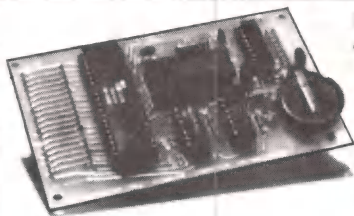
I chose to modify my BIOS to provide a 160K RAM disk, 26.5K printer buffer, and 5.5K CCP and BDOS buffer. This works well for me, but you may wish to be more ambitious and rewrite the BIOS to provide track buffering which, while a better way to use RAM, requires a lot of assembly language programming. If you do it, then I'd really appreciate a copy.

Note that plenty of multiplexer is left over on IC2 for modification to use 1 megabit chips. And with 150 or 120 nanosecond parts there would be room for a further CPU speedup to 8MHz with a Z80H.

You might ask, "Why go to all this trouble to install a 160K RAM drive when MicroSphere offers cheap RAM drives with up to a Meg of RAM. My answer: "It's fun; it's educational; and it cost me less than \$40."







## Ztime-I

CALENDAR/CLOCK

\$69 KIT

NOW WITH FILE  
DATE STAMPING!

- Works with any Z-80 based computer.
- Currently being used in Ampro, Kaypro 2, 4 & 10, Morrow, Northstar, Osborne, Xerox, Zorba and many other computers.
- Piggybacks in Z80 socket.
- Uses National MM58167 clock chip, as featured in May '82 Byte.
- Battery backup keeps time with CPU power off!
- Optional software is available for file date stamping, screen time displays, etc.
- Specify computer type when ordering.
- Packages available:
 

|                            |       |
|----------------------------|-------|
| Fully assembled and tested | \$99. |
| Complete kit               | \$69. |
| Bare board and software    | \$29. |
| UPS ground shipping        | \$ 3. |

MASTERCARD, VISA, PERSONAL CHECKS,  
MONEY ORDERS & C.O.D.'S ACCEPTED.

N.Y. STATE RESIDENTS ADD 8% SALES TAX



KENMORE  
COMPUTER  
TECHNOLOGIES

P.O. Box 635, Kenmore, New York 14217 (716) 877-0617

## Write-Hand Man

"Almost a Sidekick for CP/M"

Ted Silveira—Computer Currents, Aug. 27, 1985

"WHM is ingenious and works as intended"

Jerry Pournelle, BYTE Magazine, Sept. 1985 (c) McGraw-Hill

Now available for CP/M 2.2, CP/M 3.0 and ZRDOS!

The convenience of *Sidekick* on your CP/M machine! Trigger *Write-Hand-Man* with a single keystroke and a window pops open to run desk accessories. Exit *Write-Hand-Man* and both the screen and program are restored. Use with any CP/M program and most any CP/M machine. Takes only 5K of memory.

### FEATURES

Notepad for quick notes  
Appointment calendar  
HEX calculator

File and Directory viewer  
Quick access phonebook  
14 digit decimal calculator

### BONUS

Add applications written by you or others! No other "*Sidekick*" lets you add applications. Dump screens, setup printers, communicate with other computers, display the date and time. Let your imagination run wild!

**\$49.95** (California residents add tax), shipping included. COD add \$2. Sorry, no credit cards or purchase orders. 30 day guarantee. Formats: 8 inch IBM, Northstar and most 5 inch (please specify).

*Write-Hand-Man* only works with CP/M 2.2, ZRDOS and CP/M 3.0 (please specify). Simple terminal configuration required. Not available for TurboDOS. Compatible with keyboard extenders, hard disks, and other accessories.

### Poor Person Software

3721 Starr King Circle  
Palo Alto, CA 94306  
415-493-3735

Trademarks: *Write-Hand-Man* — Poor Person Software, CP/M—Digital Research, *Sidekick*—Borland International

## Kaypro Z-SYSTEM Now Available

Echelon proudly announces new era for 8-bit Kaypro users.

Begin using Z-System (ZCPR3 and Public ZRDOS) as easily as booting your machine!

Set yourself free from that antiquated and inefficient operating system you now use. Z-System makes your Kaypro faster, friendlier, more intelligent and powerful. See columnist Ted Silveira's 2-part article, Dec. '85, Jan. '86 *Profiles*.

- ZCPR3 Environment allows features such as Named Directories, multiple command lines, ingenious batch processing, easy use of user areas to organize your files. Be capable of editing, proofing, and printing a document in a single keystroke!
- Public ZRDOS Plus allows declaration of "public" directories, programs that use overlay files find them easily. Requirement to warm-boot after changing disk is eliminated, archive files, plus more!
- Completely compatible with your current CP/M™ programs.
- 70-page tutorial-style manual explains in detail how to make the most of Z. Numerous examples show use of Z elements: ALIASes, VFILER, ZEX, flow control, MENU processing, Resident Commands, and the utilities.
- Over 60 utility programs included.

The Kaypro Z-System is available in five different versions, determined by model you use. When ordering, please identify your machine from this list:

- Pre-'84 models
- 2, 4-84 or 2X models
- Kaypro 10 with D BIOS
- Kaypro 10 with F, G, or H BIOS
- Any model equipped with Advent TurboROM™

Prices: \$69.95 for full system on three diskettes, including Kaypro Z-System Manual; \$119.95 for package consisting of full system and Kaypro Z-System Manual, plus 350-page book *ZCPR3: The Manual* by Richard Conn, and the fast and efficient DISCAT disk cataloging system (a \$10 saving). Add \$4.00 shipping and handling, continental USA. MasterCard, Visa, UPS COD, and personal check welcomed.



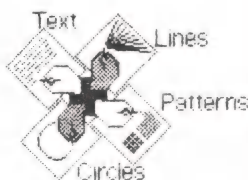
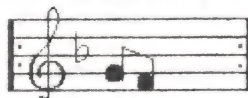
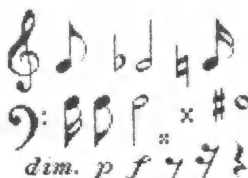
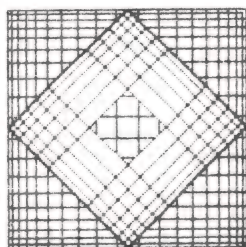
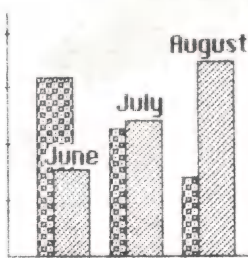
**Echelon, Inc.** 885 N. San Antonio Road • Los Altos, CA 94022 • 415/948-3820



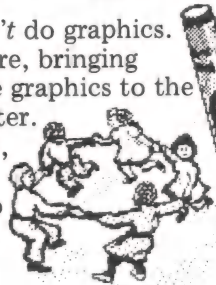


# "Kaypro makes a nice computer- too bad it doesn't do graphics"

Graphic  
Designer



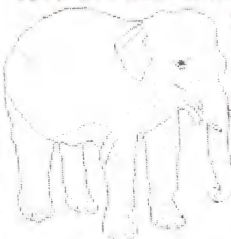
Make that *didn't* do graphics. SCS-Draw is here, bringing Macintosh-style graphics to the Kaypro computer. With SCS-Draw, you can use your Kaypro to draw a picture. Of anything.



The first true drawing program for the Kaypro, SCS-Draw turns your computer screen into a sketchpad on which you can draw detailed images like those shown here. These images can be saved on disk or printed on your dot-matrix or letter-quality printer.

There are many applications of SCS-Draw. For example, you could use SCS-Draw to design and print party invitations, banners, or technical diagrams. You could also use SCS-Draw to promote your business or design your company logo.

And the best thing about SCS-Draw is that it's fun to use — when was the last time you had some fun with your Kaypro?



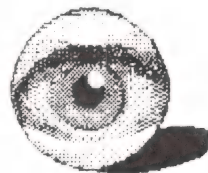
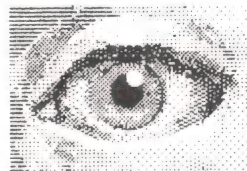
SCS-Draw gives you a variety of useful drawing tools to choose from. You can draw a detailed image dot-by-dot, or do a rough sketch with straight lines. Need a compass? SCS-Draw can draw circles of any size, wherever you need them. For subtle shading effects, use one of 23 pre-defined patterns, or create your own.



## SECOND CITY SOFTWARE

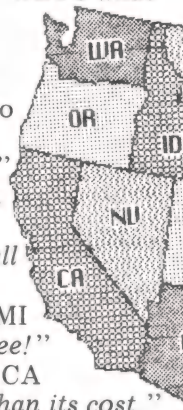
**NEW for PrintMaster Owners:** Now you can use your favorite PrintMaster images in your SCS-Draw drawings. The Image Extractor converts PrintMaster images to SCS-Draw image libraries. Price: \$24.95 SAVE when you buy SCS-Draw and the Image Extractor together: Only \$79.95

Other features include block moves, four built-in fonts, and powerful print options like enlargement, indentation, mirror image and rotation. And with SCS-Draw's windowing feature, you can work on images much larger than your Kaypro's screen.



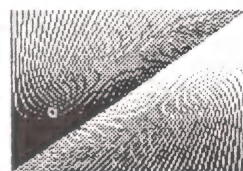
How good is SCS-Draw? Every day, we get unsolicited letters and phone calls from SCS-Draw users around the country — here's what they have to say:

"Very easy to use."  
— G.H., WPAFB, Ohio  
"Keep it up ... the program is great fun."  
— J.S., Roseburg, OR  
"A pleasure to use ... user-friendly, fun, well put together."  
— D.A., Kalamazoo, MI  
"Everything is bug-free!"  
— D.C., Los Angeles, CA  
"Worth much more than its cost."  
— B.H., Birmingham, AL



Simon & Simon  
Photography

AAAAaa  
BBBBbb  
CCCCcc  
DDDDdd



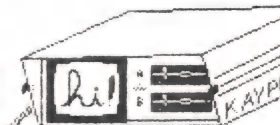
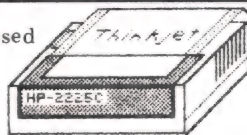
### Banners



your  
**KAYPRO**  
can  
*draw*

... with SCS-Draw! Available now for all '84, '85 and '86 Kaypro CP/M computers. Send \$59.95 (check or money order) to Second City Software, Box 267960, Chicago, Illinois 60626. Call 312-577-7680 for COD orders or more information.

SCS-Draw can be used with most popular dot-matrix and letter-quality printers, including those from Epson, Star, Okidata, C. Itoh, Panasonic, IBM, HP, Diablo and Kaypro.



SCS-Draw, KAYPRO, Macintosh, CP/M and PrintMaster are trademarks of Second City Software, Kaypro Corporation, Apple Computer, Digital Research and Unison World, respectively.





By John P. Jones

6245 Columbia Ave.  
St. Louis MO 63139  
(314) 645-1596

## Doodling On A Hercules Board

*Turbo Pascal makes the movement between CP/M and MS-DOS systems almost trivial. The "almost" part is what John talks about this time. Following that is the code to support doodling on a Hercules display with a joy stick. Some fun along with the work.*

I have resisted getting an MS-DOS machine (read "IBM compatible") for several reasons. The most important of these is that until recently, the price-performance ratio has not compared well with Z80 based designs. Also, because of my personal bias against Big Blue I've ignored many of the good points of the machine and software designs.

It is still true that many application programs will run more efficiently on a 4MHz Z80 than on a stock PC, mainly because of the Z80's 64K memory limit. Programs for the smaller address space have to be written to be compact and efficient; otherwise they would not even be possible, much less useful. Many application programs for the PC are "core hogs" badly in need of streamlining.

Why then am I writing this column on a PC clone? First, with the 8MHz clock option and an NEC V20 processor, the machine is not nearly as stodgy as the stock machine. Next, I got the machine at an extremely good price, i.e. I traded some of my time for it. Most important, however, is future software. Although there will continue to be software developed for CP/M-80 machines, new titles are dwindling and will eventually fade into oblivion. Conversely, new software for the PC will be showing up for years after Big Blue has abandoned the product line.

I still have my Big Board I, and continue to use it for several tasks. It would be prohibitively expensive to buy all the equivalent software for the clone, so the transition will be quite

gradual. With a communications and terminal emulation program I can use the PC as a terminal for the CP/M-80 machine, so I need only one CRT and keyboard.

I must admit there are some things about MS-DOS that make working in the PC environment very convenient, even fun. As I type this, every once in a while the machine quietly beeps to let me know it thinks I've misspelled something. The gem that makes this possible is Borland's Turbo Lightning, a product I can highly recommend. Once loaded, it can continually check your input for spelling errors, and when found, two or three keystrokes are all that are needed for correction.

### The Pascal Transition

I have a substantial library of Pascal code developed in the CP/M-80 environment. Since I have a winchester on the clone, most of it will eventually be transferred. What kinds of problems are likely to occur in the migration between the machines? I'm assuming that the primary problem of moving the data and source has been solved. In addition, since it has become the de facto standard for microcomputer Pascal, I'm assuming that the conversion will be between CP/M and MS-DOS versions of Turbo Pascal.

### Data Files

The only data files directly compatible between the two operating systems are TEXT files and untyped files. This is because all typed files for CP/M have a 4 byte prefix before the first record. This prefix contains the record length and record count for the file. This information cannot be derived directly from the disk directory entry as it can for MS-DOS. If you are not using 8087 Turbo or Turbo BCD, the actual data will be compatible between the two file systems.

For DOS, "file of byte" is compatible with any file. A short file copy

program written in MS-DOS Turbo which discards the 4 byte prefix is all that's needed to get to work again.

### Programs

The degree of difficulty in moving programs will depend on three major factors. First, if your programs use only standard features and extensions, there may be no translation needed at all. Two situations which may need significant massaging are operating system specific and processor specific extensions.

### Processor Differences

The processor specific extensions fall into two classes. One class is the `INLINE` statement; obviously the translation will involve conversion from one processor's machine code to the other. The other class includes all statements that either return addresses or have addresses as arguments. Eight-bit processors have a 64K address space, accessed through a 16-bit address. Integers are also represented with 16 bits, so conversions between addresses and integers are fairly straightforward. The 8088 can address a full 1024K of memory, so this needs a 20-bit address. Because of the way the 8088 is structured addresses are represented with 32 bits, a 16-bit segment value and a 16-bit offset within the segment. Turbo Pascal for the 8088 understandably does the same.

Where changes will need to be made:

1. All references to the pre-defined array `MEM`.
2. Addresses for `ABSOLUTE` variables.
3. `ORD` cannot be used on pointers for the 8088; use `SEG` and `OFS` for the variable pointed to instead.
4. `MEMAVAIL` returns its value in `PARAGRAPHS`, each 16 bytes.
5. `ADDR` can be used only for variables, not procedures or functions. You can use `OFS` for these, along with



CSEG which returns the code segment value.

Also, EXTERNAL procedures are handled quite differently for the two processors.

### Operating System Differences

CP/M-80 provides services to application programs through a standard CALL, and secondarily, allows calls to its machine specific extension, the BIOS. CP/M-86 and MS-DOS use standard software interrupts for these services. If the equivalent service is available, conversion of the software is a fairly simple change to the corresponding procedure or function for the other operating system.

1. BDOS and BDOSHL are replaced by MS-DOS (BDOS for CP/M-86). Set-up for the call is quite different and will have to be changed.

2. BIOS and BIOSHL are replaced by INTR, which generates a software interrupt for the selected function.

Since MS-DOS versions 2 and above have a tree structured directory, the OVRDRIVE procedure has been changed to OVRPATH.

So far, I haven't had too many problems in the conversion. Most difficulties have been with "fancy" and non-standard software.

### The Fun Part

I've been spending a bit of time exploring the capabilities of the new system. Since I spend most of my time on the machine in text mode, I decided on a monochrome display/adaptor combination because of the higher quality text. On the other hand, the computer is, in part, a toy so the monochrome graphics capabilities of the Hercules style video card was my final choice.

I've ordered the Turbo Graftix Toolbox (which supports the Hercules) but it hasn't arrived yet. In the interim, a set of graphics routines for the Hercules can be downloaded from the Borland SIG on Compuserve. (The files to download are HERC.SUB, HERC.DOC, and HERCDE.PAS.) This set of subroutines provides the basic tools for monochrome graphics. In addition, text at 90 X 43 is available in graphics mode.

At the urging of the kids (it didn't take much) I wrote a program to

*Listing 2 - Routine To Adjust A Self-centering Joystick  
For Zero Offset When At Rest*

```
program adjust_center;
{ First run the program to find
values for max X and Y deflection,
then adjust your centering controls
to the middle of the range. Re-run
the program & adjust for = deflection
for both directions of stick movement.}

var
  x,y : integer;
  centerx,centery : integer;

procedure readstick(var x,y:integer);

var
  i : integer;
  pots : byte;

begin
  x := 0;
  y := 0;
  port[513] := 0;
  for i := 0 to 63 do
    begin
      pots := port[513];
      x := x + (pots and 1);
      y := y + (pots and 2);
    end;
    y := y shr 1;
  end;

begin
  readstick(centery,centerx);
  while true do
    begin
      readstick(y,x);
      y := y - centery;
      x := x - centerx;
      gotoxy(1,23);
      write('X = ',x:4,' Y = ',y:4);
    end;
  end.
```

doodle on the screen. But it wasn't very exciting using just cursor control keys, so I bought a Commodore joystick, did a little rewiring, and came up with the program in Listing 1. One note of caution: I'm not sure that my rewired Commodore joystick is totally compatible with a real IBM joystick, so you may need to modify the READSTICK routine to work correctly.

Listing 2 can be used to adjust a self-centering joystick for zero offset when

at rest. READSTICK does not give very high resolution for stick position, but in this application more is not necessary. If you need higher resolution, a machine language routine would be best.

*Note: Listing 1 on pages 50 through 53.*

■ ■ ■



---

## LISTING 1 - SKETCH PROGRAM FOR SCREEN DOODLING

```
program sketch;

{$! herc.sub} { Include support for Hercules style graphics.}

label 0;
const
  maxx = 719; { pixels across in range of 0..719 }
  maxy = 330; { vertical range 0..347, leave room for prompt line at bottom }

var
  centerx,centery : integer; { center position joystick values, allow +/-
                              offsets from center }
  x,y,x1,y1, xi,yi,colr : integer; { current pos, target pos, position
                                     increment, and 'color' black or white}
  ch : char; { for keyboard input }
  switch : boolean; { fire button(s) on joystick }

procedure cursor(x,y : integer);
{ This procedure draws or erases a triangular drawing cursor at the current
drawing position. A 'color' > 127 will XOR with the background. This means
that the cursor can be drawn on top of existing pixels without losing the
information to restore them when the cursor is later moved. }

begin
  draw(x,y,x-5,y+10,128); { x & y are the top point of the triangle }
  draw(x-5,y+10,x+5,y+10,128);
  draw(x+5,y+10,x,y,128);
end;

procedure savescreen;
{ Save a drawing to a file. Just reads the screen memory (32K) and writes
it to a file for later restore. }
var
  picture : file; { untyped file }
  screen : array[0..$7fff] of byte absolute $b000:0000; { note seg & ofs }
  picname : string[30]; { allow for 'path' name for file }

begin
  gotoxy(1,43); { to bottom text line }
  write('Name of picture file: '); { prompt for file }
  cursor(x1,y1); { erase drawing cursor, don't want it in the picture }
  read(picname); { get filename }
  if pos('.',picname) = 0 then picname := picname + '.pic'; { default file
                                                             type}
  assign(picture,picname);
  rewrite(picture);
  gotoxy(1,43); { erase prompt, don't want it in picture either }
  clrscr;
  blockwrite(picture,screen,256); { use high speed file write, 256 * 128
                                   bytes }

  close(picture); { now we're done }
  cursor(x1,y1); { restore cursor }
end;

procedure loadscreen;
{ Performs the reverse operation to SAVESCREEN above with one exception, for
some reason, a BLOCKREAD from a file directly to screen memory doesn't work.
A read into a temporary variable followed by a write to the screen does the
trick. Any suggestions as to why the direct file to screen doesn't work? }
var
  picture : file;
  screen : array[0..$7fff] of byte absolute $b000:0000;
  temp : array[0..$7fff] of byte;
  picname : string[30];
```

(listing continued on page 52)



Trademarks Kaypro (Kaypro Corporation) (MicroPro International Corporation) Perfect Writer (Perfect Software, Inc.)



```

begin
  gotoxy(1,43);
  write('Name of picture file: ');
  cursor(x1,y1);
  read(picname);
  if pos('.',picname) = 0 then picname := picname + '.pic';
  assign(picture,picname);
  reset(picture);
  gotoxy(1,43);
  clreol;
  blockread(picture,temp,256);
  move(temp,screen,$7fff);
  close(picture);
  cursor(x1,y1);
end;

procedure printscreen;
{ Dump graphics screen to printer. This procedure is quite a bit more
  complex than the file save/restore procedures above. The graphics screen
  is not a linear array of pixels but is actually 4 interleaved 8K byte
  arrays. This means that the pixel on the dot row immediately below the
  current pixel is actually 8K +90 bytes (90 bytes per/row) away in the
  linear address space. In addition, conversion has to be made between row
  scan (screen) and column scan (printer). }

var
  screen : array [0..3,0..$1fff] of byte absolute $b000:0000;
  inp, out : array [0..7] of byte;
  i,j,k,l : integer;

begin
  cursor(x1,y1); { keep the cursor out of the picture }
  write(lst,^[,'3',chr(15)); { set 15/144" line feed }
  for k := 0 to 43 do { actually 43.5 sets of 8 rows }
    begin
      write(lst,^[,'L',chr(208),chr(2)); { 720 pixel columns/row }
      for i := 0 to 89 do { 90 eight byte cells/row }
        begin
          for j := 0 to 3 do { get top 4 bytes of cell }
            inp[j] := screen[j,i+(k*180)];
          if k < 43 then { if not last row, get bottom 4 }
            for j := 4 to 7 do inp[j] := screen[j-4,i+(k*180)+90]
          else for j := 4 to 7 do inp[j] := 0; { else blank bottom 4 }
          for j := 7 downto 0 do { horizontal to vertical conversion }
            begin
              out[j] := 0; { blank output byte }
              for l := 0 to 7 do
                begin
                  out[j] := out[j] shl 1 + ord(odd(inp[l])); { merge low order bit }
                  inp[l] := inp[l] shr 1; { shift in next bit }
                end;
            end;
          for j := 0 to 7 do { output 8 to printer }
            write(lst,chr(out[j]));
          end;
          writeln(lst); { ready for next row }
        end;
      cursor(x1,y1); { cursor back for drawing mode }
    end;
  end;

procedure readstick(var x,y:integer;var switch : boolean);
{ Read joystick position. A write to the joystick port triggers the
  one-shots connected to the variable resistance of the joystick pots.
  The outputs of the one-shots will remain high for a time proportional
  to the pot resistance. The X one-shot comes in on bit 0 and the Y on
  bit 1 while the 'fire' buttons are on bits 4 & 5. Inputs from the fire
  buttons will be low when pressed.}

```



```

var
  i : integer;
  pots : byte;

begin
  x := 0;           { initialize values }
  y := 0;
  port[513] := 0;   { trigger one-shots }
  for i := 0 to 40 do { loop length determined by trial & error }
  begin
    pots := port[513]; { get current value }
    x := x + (pots and 1); { sum in x one-shot }
    y := y + (pots and 2); { and the y }
  end;
  y := y shr 1;      { y comes in on bit 1, divide by 2 to
                     { get same range }
  switch := (pots and $30) xor $30 <> 0; { does NOT distinguish the
                                         { switches, either returns true.}
end;

begin
  colr := 1;           { any 'color' 1..127 is visible }
  readstick(centery,centerx,switch); { get center values for stick }
  hires;               { graphics mode }
  x1 := 359;           { start cursor in center of screen }
  y1 := 173;
  cursor(x1,y1);       { show the cursor }
  while true do        { loop forever }
  begin
    readstick(y1,x1,switch); { new stick position }
    y1 := y1 - centery;      { convert to +/- offset }
    x1 := x1 - centerx;
    if (abs(x1) > 1) or (abs(y1) > 1) then { stick 'chatters' a bit }
    { so ignore changes < 1 }
    begin
      x := x1;               { new current position = old dest }
      y := y1;
      x1 := x + x1;          { calculate new destination }
      y1 := y + y1;
      if x1 > maxx then x1 := maxx; { don't let us go off screen }
      if y1 > maxy then y1 := maxy;
      if x1 < 0 then x1 := 0;
      if y1 < 0 then y1 := 0;
      cursor(x,y);           { kill old cursor }
      if not switch then draw(x,y,x1,y1,colr); { if not pen-up draw line
                                                { between current and dest }
      cursor(x1,y1);         { cursor at new position }
    end;
    delay(50);               { it's a bit fast without this }
    if keypressed then       { check for keyboard command }
    begin
      read(kbd,ch);          { get command char }
      case ch of
        'q','Q' : goto 0;    { Quit }
        'e','E' : colr := 0; { Erase mode, draws in background color }
        'd','D' : colr := 1; { Draw mode }
        's','S' : savescreen; { Save screen to file }
        'l','L' : loadscreen; { Load screen from file }
        'p','P' : printscreen; { Print screen }
        'c','C' :             { Clear screen }
      begin
        hires;
        cursor(x1,y1);
      end; { case 'C' }
    end; { case ch of... }
  end; { if keypressed then... }
end; { while true do... }

0:
textmode;
end.

```

End of Listing



# PC-DOS For Non-Clones

## Writing A Custom BIOS Interrupt By Interrupt

By Fred Greeb

LogiCom, Inc.  
P.O. Box 27465  
Lakewood CO 80227

*CP/M-80 systems aren't the only ones affected by the market's strong move toward PC-DOS. Even 8088/8086 based systems such as Fred's S-100 have been left without support.*

*In this article Fred covers, step by step, what he went through to write a PC-compatible (or mostly compatible) BIOS for his system. In the process he learned a lot about PC-DOS. This is a cook's tour of PC-DOS that no self-respecting technical type should miss.*

**W**as my system obsolete? Did I need to replace it with a new one? These questions had been running through my mind for quite some time. My dual processor S-100 system running CP/M-80 and CP/M-86 had served me, but most of the new developments were centered around PCs running PC-DOS.

I didn't really want to replace the computer, but it seemed I needed at least some degree of PC compatibility to keep up.

Since one of my processors was an 8088 I decided the easiest and least costly route was to get the PC- (or MS) DOS operating system to run on my hardware.

### So For Starters

I obtained the IBM hardware reference manual, which contains a complete listing of the BIOS ROM used to interface PC-DOS to the IBM hardware.

After studying the manual, I concluded that there was a good chance that PC-DOS would run on my hardware. This article describes the results of that effort and outlines the steps required to implement PC-DOS.

By following this procedure an experienced assembly language programmer should be able to implement PC-DOS on any 8086 computer system.

The resulting system is best de-

scribed as generic PC-DOS. Software designed for the IBM-PC (or compatibles) which uses only normal DOS system calls to perform I/O functions will run properly. Software which uses unique features of the machine, such as graphics, or software which accesses the hardware directly, will not run properly.

### Requirements & Approach

In order to run PC-DOS you'll need either an 8088, 8086, 80186, or 80286 CPU, 128K RAM, a 5.25" disk drive and controller (DD), a terminal or other form of console device, PC-DOS version 2.1, a text editor, an 8086 assembler, linker, and loader.

The PC contains the primitive I/O functions for accessing the various components of the hardware in its BIOS (Basic Input/Output System) ROM. This ROM contains all the routines for accessing the available standard hardware.

The routines are accessed via software interrupts, so their physical location isn't critical to proper operation of PC-DOS. If the routine is moved, you need only adjust the interrupt vectors to access the routine at its new address.

### The BIOS

I had to write a BIOS module to provide the I/O functions for my hardware. In it I tried to adequately support normal PC-DOS function calls and to return harmless values for those functions which return information unique to the PC's hardware.

This new BIOS is loaded into RAM from CP/M-86 in my system, but it could be placed in ROM so that it's always available. The BIOS includes the boot routine to load PC-DOS from disk and to begin its operation.

The normal location for the BIOS code is at the top of available memory. This leaves the largest possible block of contiguous memory for PC-DOS. It

isn't necessary for the BIOS code to be in a contiguous portion of main memory. On the IBM-PC it's located in the top 8K of the 1 megabyte address space of the 8088 microprocessor.

DOS can use a maximum of 640K of memory so there's a large gap between DOS and the BIOS. If you want to put the BIOS code in ROM, this is a good approach to use.

### Interrupts

You can implement PC-DOS either with interrupt driven I/O or with polled I/O. I set up hardware interrupts for the keyboard and a clock only. The interrupt driven keyboard provides a type ahead capability, but isn't necessary for operation of DOS. The clock maintains the time and date.

The IBM-PC uses software interrupts hex 10 through hex 1F to access the BIOS ROM functions. PC-DOS reserves software interrupts hex 20 through hex 3F for its use. Interrupts hex 08 through hex 0F are reserved for the various hardware components contained in the PC. Interrupts hex 00 through 07 and interrupts hex 40 and 41 are also reserved. If you're using a system with hardware interrupts, they should not use any of these values.

If your hardware uses a non-programmable approach to hardware interrupts and a conflict exists, you need to provide some means of distinguishing between a DOS generated software interrupt and a hardware interrupt. This greatly complicates the problem.

### BIOS Initialization

The first function I implemented in the BIOS was initialization of the interrupt vectors. Even if you're not using hardware interrupts, the interrupt vectors must be initialized since all the BIOS functions are accessed through software interrupts.

After the interrupt vectors have been set, I initialize the few memory varia-



bles required by the BIOS. These variables are defined in the detailed descriptions of the BIOS interrupts and in the BIOS listing. The BIOS uses a low address memory segment for data storage. I don't recommend changing the data segment location, since that's where PC-DOS expects it.

Next, initialize the system hardware. This includes setting the serial device baud rates, data bits, parity, etc., and initialization and start up of the clock. Interrupts are then enabled and the boot routine to load DOS is entered via a software interrupt.

### Interrupt Descriptions

Data is passed to the software interrupt handlers via the CPU registers and returned from the handlers both in the registers and in the processor flags.

The following descriptions define the functions performed by each software interrupt, the data passed to it, and the data returned from the routine.

#### Interrupt 10 — Video Output

This is one of the most complex interrupt handlers in the PC BIOS ROM. It provides support for both simple character output and black/white and color graphics. Since I have an ASCII terminal, I wrote my BIOS to support only simple character output.

The function to be performed is passed to the interrupt handler in the AH register. A total of 15 functions are supported by the PC ROM BIOS. These functions, along with the action taken by my generic BIOS, follow. My BIOS ignores 00, 01, 02, 03, 04, 05, 06, 07, 11, and 12.

AH=00 — Sets black and white or color output, as well as character or graphics mode.

AH=01 — Sets the cursor type used by the PC.

AH=02 — Sets cursor position.

AH=03 — Reads the cursor position. This function is ignored by my BIOS, and always returns a value of zero.

AH=04 — Reads the light pen position. This function is ignored by my BIOS. It returns zero to indicate no light pen.

AH=05 — Selects the active display page.

AH=06 — Scrolls the active page up.

AH=07 — Scrolls the active page down.

AH=08 — Reads the attribute/character at the current cursor position. My BIOS returns AX=0 (character and attribute) and BH=0 (active page).

AH=09 — Writes the character/attribute at the current cursor position. My BIOS treats this as normal character output. The main difference is that the PC BIOS does not advance the cursor position for this function (or for function 10), and my BIOS does. The character to be output is in the AL register.

AH=10 — Writes the character at the current cursor position without advancing the cursor. My BIOS also treats this as normal character output. The character to be output is in the AL register.

AH=11 — Sets the color palette.

AH=12 — Write graphics dot.

AH=13 — Read graphics dot. My BIOS always returns AL=0.

AH=14 — Teletype (TTY) output. This is the normal output mode for all of my BIOS output functions. This function is used by the DOS character output function calls. The character to be output is contained in the AL register.

AH=15 — Return the current video state. My BIOS returns AL=2 (80 by 25 black and white), AH=80 (number of columns on the screen), and BH=0 (current active page number).

This function becomes a simple character output routine to send data to the terminal. The terminal is interfaced via a serial port, and operates in a polled I/O mode. If the interface isn't ready when this routine is called, it waits until the character can be sent before returning to the calling program.

If you use a different type of console driver (memory mapped video board, for example), you may want to incorporate some of the other features (read screen, etc.) into your interrupt handler.

Simple character output is the only function necessary for operation of PC-DOS.

#### Interrupt 11 — Equipment Check

This interrupt returns a data word which defines the hardware present in the system.

In the PC this value is determined by reading the switches on the motherboard. Since my system doesn't have these switches, I set this data word in the initialization code. The value is returned from this routine in the AX register.

The meanings of the 16 bits which form the equipment definition are as follows:

Bit 0 — If this bit is 1, it indicates that floppy disk drives are present in the system. If zero, no floppy disks are contained in the system.

Bit 1 — Not used, set to zero.

Bits 3,2 — Indicate the base RAM size. This is a carryover from the original IBM-PC, which could accommodate a maximum of 64K RAM on the motherboard. I don't know if these bits are required by PC-DOS, but it's best to set them to their maximum value of 11, indicating 64K of motherboard RAM. The other values are 00 = 16K, 01 = 32K, and 10 = 48K.

Bits 5,4 — Indicate the initial video mode for the monitor interface. Set to 11 for 80 by 25 black and white. Other values are 00 = not used, 01 = 40 by 25 color graphics card, 10 = 80 by 25 color card.

Bits 7,6 — Indicate number of floppy disk drives (5.25", IBM format) contained in the system. Bit 0 must be one for this parameter to have any meaning. The values are 00 = 1 drive, 01 = 2 drives, 10 = 3 drives, and 11 = 4 drives.

Bit 8 — Not used, set to zero.

Bits 11,10,9 — Indicate the number of RS-232 serial interface cards contained in the system. Do not include the serial interface to the system console.

Bit 12 — Indicates that a game I/O interface is present if set to 1.

Bit 13 — Not used, set to zero.

Bits 15,14 — Number of printer interfaces in the system. This can be misleading, since the IBM BIOS assumes that printers are interfaced via a parallel port (Centronics type interface). If you use a serial interface to the printer set these bits to zero. The DOS MODE command can be used to redirect the printer output to a serial port.

*(continued next page)*



(continued from page 55)

#### Interrupt 12 — Memory Size

This interrupt returns a data word (in the AX register) which indicates the number of contiguous 1K blocks of memory in the system. The maximum RAM supported by the PC is 640K.

#### Interrupt 13 — Floppy Disk I/O

This interrupt handles all floppy disk I/O requests for 5.25" disks. The function to be performed is contained in the AH register.

All of the functions return information in the carry flag and the AX register. If the carry flag is clear, the operation was successful. In this case, the AH register is returned as zero, and the AL register contains the number of sectors of data transferred by the operation. If an error occurred, the carry flag is set, and AH contains the error code.

The AL register indicates the number of sectors transferred (it may not be the same as the number requested).

Here are the five functions handled by this routine —

AH=0 — Resets the disk system. No physical request need be sent to the disk controller by this command. A memory variable is set indicating the disk status is unknown and a home (seek track zero) operation should be performed by the next read or write. This function should always return with the carry flag clear to indicate successful completion, and zero the AH and AL registers.

AH=1 — Reads the status of the floppy disk system. This function returns the status of the last disk operation in the AL register. The carry flag is set according to the value of the status word returned.

AH=2 — Reads sectors from the floppy disk into memory.

AH=3 — Writes sectors from memory to floppy disk.

AH=4 — Verifies sectors with data in memory. No actual data transfer should occur.

AH=5 — Formats (initializes) the track.

For the read, write, and verify operations, data is passed to the routine in registers in the following manner:

DL — Contains the drive number, 0 through 3.

DH — Contains the head number, 0 or 1.

CH — Contains the track number, 0 through 39.

CL — Contains the sector number, 1 through 9.

AL — Contains the number of consecutive sectors to transfer.

ES — Contains the segment for the data.

BX — Contains the offset for the data.

In other words, ES:BX is the data address.

For the disk format operation, ES:BX points to a table of parameters which supplies information for the format operation.

The table contains the track, head, sector, and sector size code — one entry for each sector to be formatted. This data is for the NEC 765 floppy disk controller chip (standard in the PC and clones). If your system uses this same chip, you can incorporate the format code into the BIOS.

My system has a Tarbell double density disk controller, which uses the Western Digital 1793 controller chip. The 1793 requires completely different data to initialize a disk, and therefore

the format code is not included in the BIOS.

#### Floppy Disk Controller

I used DMA (Direct Memory Access) to transfer data between the controller and memory. This isn't a requirement, and a programmed I/O controller could just as easily be used. Only the read/write code in the interrupt handler would have to be changed.

#### Interrupts

The interrupt handler checks each request and returns a bad-command error code if the requested function isn't available. This check must be made since a hard disk controller, for instance, uses additional functions, which are also passed in the AH register.

The BIOS interrupt vector for the floppy disk I/O function is modified by the ROM contained on the hard disk controller card. DOS determines the presence of a hard disk by requesting one of these higher numbered functions. If the BIOS returns a bad command error, it assumes that no hard disk is present in the system, and only accesses the floppy disk drives.

# The Best Debuggers. Period.

DSD86, The PC-DOS Debugger ..... 69.95

DSD87, The PC-DOS Debugger with 8087 Support . 99.95

DSD80, The CP/M Debugger ..... 125.00



SoftAdvances



P.O. Box 49473 • Austin, Texas 78765 • (512) 478-4763

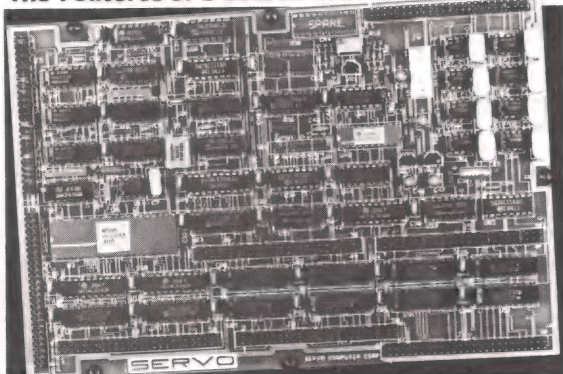
1-800-232-8088



## SERVO INDUSTRIAL PROCESS CONTROL BOARD

### 14 Bit Lab Accuracy Industrial Durability

The Features of 5 Boards in One.



The Servo Process Control Board is a general purpose multi-channel analog and digital input/output controller which can communicate with and control most medium-scale industrial processes. Designed to work with the Servo Industrial Microcomputer, (or other computers which support the SASI interface), it offers great accuracy at prices starting as low as \$495.

■ American made ■ MILSPEC components ■ 1 year warranty

Maximum configuration includes: ■ 192 analog inputs ■ 64 analog outputs ■ 128 digital inputs ■ 512 digital outputs

■ Based on the INTERSIL 14 Bit A to D converter ■ Communicates with any micro or mainframe computer ■ Easily programmed in high level languages (Turbo Pascal, Microsoft Basic, Forth) ■ PID, FFT, Thermocouple linearization and laboratory DAS software supplied. ■ Custom software and hardware engineering assistance available.





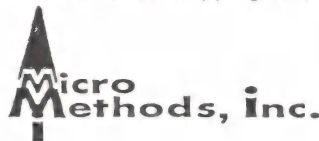
360-B N. Ellensburg St.  
Box 566  
Gold Beach, OR. 97444  
(503) 247-2021

## RP/M2™ creates

## CP/M®2.2 compatible IBM PC

1. Remove the 8088
2. Install the NEC  $\mu$ PD70108 (V20)
3. Boot PC RP/M2

The  $\mu$ PD70108 chip is a fast 8088 that also executes 8080 machine code. PC RP/M2 is an **operating system**. Either standalone or with MSDOS present, PC RP/M2 provides the solid base of a genuine operating system reliably distinct from the facade created by an MSDOS interface. All 2.2 features are supported with 56.5k TPA, plus file date and time stamping, fast virtual disk, iobyte redirection, terminal cursor positioning, color console display. DOSDISK accesses MSDOS drives; MODEMPC transfers files via serial port; SETDISK redefines a drive to any of over 80 formats, allowing PC RP/M2 to directly process existing CP/M files in their native form. Two system disks plus 105 page user and technical manual \$129. Shipping \$5 (\$10 nonUS)  



118 SW First St. - Box G  
Warrenton, OR 97146  
(503)861-1765

### Disk Accesses

The first function performed by the disk read and write routines is a call to the DMASET routine.

This routine translates the data segment and offset (contained in ES:BX) to a page and offset form. Page refers to a 64K bank of memory, and offset to the location within that page. This is done due to a hardware requirement of the Tarbell and PC disk controller.

The Tarbell controller uses a register to hold the top 8 bits of a 24-bit address for data transfer, with the low 16 bits set by the DMA controller chip.

The top 8 bits are fixed for a single data transfer, so data transfer across a 64K boundary isn't possible. Therefore, after sending the page number (bank) to the controller and saving the offset address, the routine checks to see if the transfer will cross a 64K boundary. If so, the carry flag is set, and the I/O function is terminated with a DMA boundary error.

I haven't determined if this error should be returned if you have a controller which doesn't have this limitation. For example, a programmed I/O controller (like the CompuPro floppy disk controller) could easily transfer

data across a 64K boundary.

Since it's a feature of the PC, I recommend you retain the function and purpose of the DMASET routine, even if it isn't necessary for your controller.

### MSETUP

The MSETUP routine in the BIOS listing is configured for a single floppy disk drive, and must be modified for multiple drives.

Only the MSETUP routine is affected by the use of multiple drives. A pause is built into this routine to allow the drive motor to come up to speed, since the Tarbell does not have a means to test the ready condition of 5.25" drives. If your controller polls the drives, the delay can be replaced with a ready test.

### Data Transfer

The routine MDAMRW initiates the data transfer by sending commands to the DMA and floppy disk controller. Then after these chips have handled the job, it tests for an error condition.

If an error is found, the error code is translated to the code expected by DOS, and the zero flag is cleared. If

there's no error, the status parameter is set to zero, and the zero flag indicates no error.

DOS handles all of the retry functions, so there's no retry logic for the seek or read/write routines in the BIOS.

After a successful data transfer (an error would terminate the routine), the read/write code checks for a multiple sector transfer request and transfers additional sectors if needed.

### Transferring Multiple Sectors

I have to deal with multiple sector transfers because the 1793 controller chip isn't set up for the type of multiple sector requests issued by DOS.

The 1793 can transfer multiple sectors with a single command, but the ending sector must be the last sector on the track. So multiple sector requests are handled as a series of single sector transfers by the BIOS, transparent to DOS.

If the number of sectors requires reading beyond the end of the current track (as specified by the disk param-

(continued next page)



(continued from page 57)

ters, see interrupt 1E), the routine is terminated with a Sector Not Found error.

The common return code for all functions sets the carry flag according to the value of the status word stored by the I/O handlers, and then returns to DOS. An interrupt return instruction can't be used because it would restore the flags to their original condition, and the carry flag would no longer indicate the function status.

The RET 2 instruction throws away the old value of the flags, preserving the carry flag as set by the interrupt handler. The verify command returns the success status.

## Format

I set up the format command as a simple (successful) status return. This allows the DOS format command to work properly, assuming the disk has been physically initialized prior to issuing the command.

DOS FORMAT writes the boot record on the disk, initializes the directory, and optionally writes the operating system on the disk.

If FORMAT returned an error, it wouldn't be possible to generate a bootable disk with the generic PC-DOS system. So you'll need a separate program to initialize a blank disk (a minor inconvenience). The program I use runs under CP/M, but it could be rewritten for PC-DOS.

If you're using a disk controller with the NEC 765 controller chip (or its equivalent, the Intel 8272 chip), you'll probably be able to use code very similar to that in the IBM BIOS ROM. Except for drive select, motor on, etc., most of the code should work with very little modification. The port addresses will undoubtedly be different, but the commands should be the same.

## Interrupt 14 — Communications Port I/O

This interrupt handles all communications with the serial ports. The function to be performed is in the AH register, and the port number is in the DX register.

The port number refers to the IBM communications port number, not the



# Z SETS YOU FREE!

**Z Operating System, an 8-bit OS that flies! Optimized HD64180/Z80 assembly language code — full software development system with proven linkable libraries of productive subroutines — relocating (ROM and RAM) macro assembler, linker, librarian, cross-reference table generator, debuggers, translators and disassemblers — ready to free you!**

High performance and flexibility! Productivity results from dynamically customized OS environments, matching operator, tasks and machine.

Real-time control kernel option allows quick software development for industrial control applications, other tools and utilities for office desk-top personal computing functions, local area networks to Ethernet, AppleTalk, Omnet, ArcNet, PC-Net (Sytek) — from micro to mainframe command, control and communications. Distributed processing application programs are easily developed.

- Extreme organizational flexibility, each directory another environment
- Multiple Commands per line
- Aliases (complex series of commands known by simple names) with variable passing
- Named Directories with absolute password security
- Full-screen command line editing with previous command recall and execution
- Shells and Menu Generators, with shell variables
- Command-file search Paths, dynamically alterable
- Screen-oriented file manipulation and automatic archiving and backup
- 512 megabyte file sizes, 8 gigabyte disks handled
- Auto disk reset when changing floppies
- TCAP database handles characteristics of over 50 computers and terminals, more easily added
- Tree-structured online help and documentation subsystem
- 76 syntax-compatible support utilities

**Your missing link has been found — Z! Now fly with eagles! Fast response, efficient resource utilization, link to rest of computing world — shop floor to executive suite, micro to corporate mainframe. Call 415/948-3820 for literature.**



**Echelon, Inc.** 101 First Street • Suite 427 • Los Altos, CA 94022 • 415/948-3820

physical port address. Port number 0 is the first communications port, 1 is the second, etc.

The functions which are available are:

**AH=0** — Initializes the port, returning the full port status in the AX register.

**AH=1** — Sends the character in the AL register, returning the line status in the AH register.

**AH=2** — Receives the next character in the AL register, waiting until a character is available, and returns the line status in AH.

**AH=3** — Returns the full port status in the AX register.

Most of these commands are straightforward, and should present no problems. In my system, the initialize command is ignored, and merely returns the system status. All port initialization is done in the BIOS ini-

tialization, prior to booting the system.

The system status consists of data ready bits in the AL register, and the modem status line conditions in the AH register. The data status bits are bit zero set for data ready to receive (test with 01h), and bit 5 for ready to transmit (test with 20h). My BIOS uses bit 5 of the line status register to test DTR, and will not transfer data unless this line is low. This is reversed from some systems, so if your system hangs when you try to do serial output, reverse (or eliminate) this test.

I use the serial ports in my system for the printer and a modem. The serial ports are not required for operation of DOS. If you do not have any serial interfaces in your system this code can be replaced by the dummy return point in the BIOS. If your terminal is interfaced by a serial port, it should not use this interrupt han-



# PUBLIC DOMAIN SOFTWARE

FOR \*ALL\* COMPUTERS FROM THE LARGEST LIBRARY IN THE WORLD!

Rent or buy complete user group libraries! (Or select individual disk: ONLY \$4.00 each.)

Since it's not copyrighted, PD software may be freely distributed. Get accounting, dbase, Games, Word Processors, Educational, Communications, Utilities, Spread Sheets and hundreds more! User Group libraries are expanding every month as new software is contributed, get the latest info: a directory disk and catalog — only \$5.00 postpaid! (Specify computer).

Browse through a rental library — copying out programs of interest to build your very own special interest library!

| IBM-PC COMPUTERS                          |  | Rent  | Buy   | CP/M COMPUTERS - 300 Formats Available                            |  | Rent  | Buy   |
|---|--|-------|-------|---|--|-------|-------|
| IBM-PC SIG 454 Disksides                  |  | \$460 | \$845 | SIG/M UG 260 Disksides  |  | \$175 | \$600 |
| PC-Blue 187 Disksides                     |  | \$190 | \$375 | CP/M UG 92 Disksides  |  | \$ 45 | \$249 |
| Capitol-PC 35 Disksides                   |  | \$ 40 | \$105 | CP/M 86 25 Disksides  |  | \$ 25 | \$100 |
| Author's Showcase 25 Disksides            |  | \$ 50 | \$100 | Kaypro UG 60 Disksides  |  | \$ 70 | \$230 |
| <b>COMMODORE 64</b>                       |  |       |       | Epson UG 58 Disksides   |  | \$ 70 | \$220 |
| PC Gold 102 Disksides                     |  | \$100 | \$200 | <b>ATARI ST</b>   |  |       |       |
| C-64 28 Disksides                         |  | \$ 25 | \$ 65 | STD PD 25 Disksides   |  | \$ 50 | \$100 |
| Amiga 25 Disksides                        |  | \$ 50 | \$100 | Disk downloading service — \$10.00 first disk, \$5.00 thereafter. |  |       |       |
| <b>APPLE (Also CP/M Format Available)</b> |  |       |       | No label disk sales \$.69¢ with PD order. Rentals are for 7 days, |  |       |       |
| Best of DOS 120 Disksides                 |  | \$120 | \$200 | 3 more days grace for return. We use UPS.                         |  |       |       |
| Macintosh 74 Disksides                    |  | \$ 80 | \$225 |   |  |       |       |

Call (619) 727-1015 for 3 minute info recording. Call (619) 941-0925 for technical info. Call 1(800) 621-5640, wait for tone, then dial "PUBLIC" for orders only. Send large \$.39¢ stamped envelope for free catalog.

**NATIONAL PUBLIC DOMAIN SOFTWARE LIBRARY, 1533-A AVOHILL, VISTA, CA 92084**

pler. The communications I/O interrupt should be reserved for use only by additional serial ports in the system.

## Interrupt 15 — Cassette I/O

This interrupt is used to interface a cassette tape recorder to the IBM-PC and is not used in my BIOS.

## Interrupt 16 — Console Input

This handles all requests for keyboard data from the system. There are three available functions contained in the AH register on entry to this routine —

AH=0 — Reads the next key, waiting until one is available.

AH=1 — Returns the data available status in the Z (zero) flag. If the Z flag is set it means that no data is available. If the Z flag is clear, data is available, and the character is returned. The character read is not destroyed, but will be available for the next read function request. This is often referred to as a non-destructive read operation.

AH=2 — Returns the shift status.

The IBM keyboard is unencoded, and merely puts out a scan code. The ROM BIOS returns the ASCII translation in the AL register, and the raw scan code in the AH register. My terminal outputs ASCII data, and the scan code is always returned as zero. If you want to include the extra code to return the scan codes, it could be done via a look-up table. The scan codes for the keys on the IBM-PC are listed in the IBM hardware technical

reference manual and are simply the numerical codes assigned to each key.

I use an interrupt driven keyboard, but you don't have to. If you use a polled keyboard, make sure you implement the status routine properly so it returns the status without destroying the character (so a subsequent read can retrieve it). This means that the status routine must buffer one character.

## Interrupt 17 — Printer Output

This interrupt is for printer output via a Centronics interface. This is the default printer mode for PC-DOS. I did not use this interrupt, but if you need it, the following functions are available:

AH=0 — Prints the character in the AL register. Returns the status in AH. Sets AH to indicate a time out error if the character could not be printed. Sets any other status bits as appropriate.

AH=1 — Initializes the printer port and returns the status in AH.

AH=2 — Returns the printer status in the AH register. The status bits are defined as follows:

- Bit 0 — Set for a time out error.
- Bit 1 — Not used.
- Bit 2 — Not used.
- Bit 3 — Set for I/O error.
- Bit 4 — Set for printer selected.
- Bit 5 — Set for out of paper.
- Bit 6 — Set for acknowledge returned from the printer.
- Bit 7 — Set for not busy condition.

For all functions the printer number (not the port number) is contained in the DX register on entry to the interrupt handler.

## Interrupt 18 — BASIC

This interrupt provides access to the BASIC ROM in the IBM-PC, and is not used by my BIOS.

## Interrupt 19 — Bootstrap

This interrupt reads the boot sector (track 0, sector 1) from the disk in the first floppy disk drive. The data is placed at address 0000:7C00 (segment:offset), and if a successful read occurs, the bootstrap program is then executed from that address.

If an error occurs, the program continues looping (forever) until a successful read is accomplished. The disk I/O interrupt (interrupt 13 hex) is used to access the disk I/O routines, so there are no hardware dependent parameters in the boot routine.

You may want to implement an error message after several retries to provide some indication that the system isn't completely hung up. The normal cause for this error would be an unformatted disk, since the boot routine does not check the data which it loads from the boot sector.

## Interrupt 1A — Time Of Day

This interrupt either reads the timer counters (AH=0) or sets them (AH=1). Even if you don't have a clock in your system, you should

(continued next page)



(continued from page 59)

preserve this function and the three counter locations used by this routine so the read time function will return the last value stored by the set time function.

#### Interrupt 1B — Keyboard Break

This interrupt is used by some application programs to handle a keyboard control break input. It should be initialized to point to an interrupt return instruction.

#### Interrupt 1C — User Timer Function

This interrupt is included in case an application program wants to do something special on each tick of the hardware clock. It's executed every time the clock interrupt handler is entered. It should be initialized to an interrupt return instruction.

#### Interrupt 1D — Video Parameters

This is not an interrupt but is used as a pointer to parameters for the video card in the PC. This pointer serves no useful purpose in my system, but it should not be used for any other purpose.

#### Interrupt 1E — Floppy Disk Parameters

This is also a pointer defining the address of the parameters required for operation of the floppy disk.

The pointer is initialized to the data contained in the BIOS, but is modified by PC-DOS to reflect the actual disk format being used.

The floppy disk I/O routines use data from this parameter block to perform the read/write operations. The data contained in the parameter block includes the sector size and the sectors per track, as well as some data unique to the NEC floppy disk controller chip.

#### Interrupt 1F — Graphics Parameters

This is also a pointer which is used when the IBM video is operating in the graphics mode. It is not used in my BIOS.

#### Interrupts 40 and 41 — Fixed Disk

These interrupts are reserved for the hard disk controller board which may be used in the PC, and should not be used for any other purpose.

### Implementing Generic DOS

Modify the BIOS source code to match your hardware requirements. Pay particular attention to those software interrupt handlers which return information in the flags. These routines must not end with an interrupt return instruction, since that would restore the original state of the flags. Assemble the modified program and correct any errors.

When the code assembles correctly, it's necessary to generate an executable file. This code should be linked to run in high memory, above the memory available to PC-DOS.

After you've generated the executable BIOS file, run it to boot PC-DOS into the system. (With CP/M-86, I type in "PCBIOS," the name of my executable BIOS.)

If all goes well, the BIOS will read the boot sector into memory, and execute it to load the rest of PC-DOS. PC-DOS will request the date and time, and then display the familiar A> prompt on the screen.

### Debugging The BIOS

Unless you're exceptionally lucky, the first run won't be perfect. The system will hang up, leaving little indication of the problem. Time for debugging.

Debugging the BIOS isn't as easy as debugging a normal application program since the first thing the BIOS program does is modify all the interrupt vectors. So any normal debugging tools you have, such as DDT86 under CP/M-86, can't be used. Instead we leave messages at the end of the program.

### Messages

By including these messages at the entry and exit of the various BIOS interrupts, you can get a good idea of what is going wrong. In the program listing, the message print routines can be enabled for the disk I/O routines by setting the parameter debug13 true. Other messages can be incorporated in a similar manner.

The message print and register dump routines preserve the state of all registers and flags, so they can be used without modifying any of the parameters passed to or returned from the interrupt routines.

### Register Dumps

The register dump routine uses memory variables in the BIOS code segment, so if it is incorporated, the BIOS must be in RAM memory. If you're going to put the BIOS in ROM, remove the register dump routine after you've debugged the code.

Proceed logically through the check-out procedure. If you don't enter the interrupt 19 (bootstrap) routine, something is wrong with your BIOS initialization code. If you get to this point, but there is no disk activity, the problem is probably in your disk read logic.

If you get past this point, but there's nothing on the screen, the problem may be in the video output routine. It's possible the initialization of the serial and parallel ports can be causing the problem, but this can be eliminated by using a simple return from interrupt instruction for these two interrupt handlers.

If you get a sign-on message, but there's no response to the keyboard, check your keyboard read routine.

### Port Contention

Another potential problem area in some systems is the initialization code contained in the file IBMBIO.COM, which is the first file loaded by the boot routine.

One of the first things this code does is output a value of 20 hex to port number 20 hex. This clears any pending interrupt requests.

If this port number conflicts with any ports on your system and causes undesirable effects, it'll be necessary to patch it out using whatever tools you have available.

The four bytes of code which send this output are B0 20 E6 20 (hex). Change these bytes to NOP instructions (90 hex) to disable the output. The four bytes are located 1975 bytes (decimal) from the beginning of the start of the file. In terms of absolute track and sector number, they begin at byte number 439 of track 1 sector 4 on a single sided PC-DOS 2.1 floppy disk.

There may be other ports in the PC which could cause conflicts with your hardware. The one listed above (port 20H) is the only one I've found which is addressed directly from PC-DOS,



Table 1 - IBM-PC Port Addresses

| Port Address | Function  |
|--------------|---|
| 00-0D        | 8237 DMA controller chip.   |
| 20-21        | 8259 interrupt controller chip.   |
| 40-43        | 8253 timer chip.  |
| 60-63        | 8255 parallel interface chip. Used for keyboard, sense switches, and cassette tape interface. |
| 81-82        | DMA page register.  |
| 201          | Game card.  |
| 210-216      | Expansion box interface.  |
| 278          | Printer card #3 base address.   |
| 2F8          | Serial card #2 base address.  |
| 320          | Hard disk base address.   |
| 378          | Printer card #2 base address.   |
| 3B4-3BA      | 6845 video controller chip, BW.   |
| 3BC          | Printer card #1 base address.   |
| 3D4-3DA      | 6845 video controller chip, color.  |
| 3F2-3F5      | Floppy disk controller.   |
| 3F8          | Serial card #1 base address.  |

rather than via a BIOS interrupt routine.

Table 1 lists the ports I've found on the PC. If you have ports with these same physical addresses, and are experiencing problems, you may want to check for any input or output instructions to these ports.

This isn't easy without some form of debugging tool. If you can get PC-DOS to run at all, you might be able to use the debug program which is part of it. If you're running CP/M-86, and have a way to move files from the PC-DOS disk to one of your CP/M disks, you could use DDT-86 for this purpose.

Many of the port addresses are 16 bits long. If your hardware uses only the low 8 bits for I/O port addressing, the 16-bit addresses could inadvertently address undesirable ports.

#### Home Free

After you get PC-DOS to successfully boot and sign on, the checkout procedure is almost complete. About the only things you haven't tested are the disk write routines. Try copying some files from one disk to another. If you have the system configured for only one floppy disk, PC-DOS will tell you when to swap disks in the drive

for those operations which require two diskettes.

#### Restrictions

This system is definitely not the equivalent of a PC. In general, programs which use normal PC-DOS system calls for I/O will run OK. Programs which take advantage of special features of the PC hardware will not. ROM BASIC, of course, will not.

Programs which require graphics capability, such as Flight Simulator, won't run since no graphics capability is included in the BIOS.

Copy protected software probably won't run, since most of the copy protection schemes access the disk controller directly, rather than using DOS (or even BIOS) calls.

I've tested all the general purpose utilities on the PC-DOS system disk — CHKDSK, DEBUG, SORT, etc. They're OK. Many compilers and editors run fine.

#### Additions?

One useful function would be to set up the terminal function keys to return codes compatible with the IBM keyboard function keys. This would be useful with some DOS functions and some application software.

## NEW INTEGRATED BIOS FOR BIGBOARD II

This BIOS adds special features to your Bigboard II floppydisk and/or Winchester system.

Read, write and format any 5" and/or 8" disk formats. 40 formats included. Use any type of 5" and/or 8" drive. New SYSGEN works between 5" and 8".

### INCLUDES:

- CONFIGURATION program that lets you install any new floppy disk format INTERACTIVELY.
- FORMATTER allows you to format almost any diskformat.
- PC-COPY reads and writes PC diskettes on your Bigboard II.
- MONITOR EPROM with serial keyboard and translate table.
- 300 page ZCPR2 manual.
- 60 page BIGBOARD II tech manual.
- BOOTABLE DISK contains free ZCPR2 and P2DOS system. With TIME and DATE stamping. BIOS also has provisions for 256K RAM disk, Centronics, system in ROM.
- WINCHESTER FORMATTER and SYSGEN Supports XEBEC, W-D and ADAPTEC type controllers. Subdivides into any specified number of drives.

**Price: \$99.95 (specify disk)**

### ANDY BAKKERS

de Gervelink 12 • 7591 DT Denekamp  
The Netherlands • Tel: 31-5413-2488  
Please pay with US\$ Money Order.  
MC or VISA welcome.

Also, some software looks at the scan code returned by the keyboard rather than the ASCII value of the key. By setting up the BIOS to return the proper scan codes, more software may be available for use with the generic system. This function could be implemented with a fairly simple look-up table.

#### Finally

By taking the software approach implementing PC-DOS, I have achieved some degree of PC compatibility without the expense of new hardware.

I'll probably expand my PC-DOS implementation to include my second 5.25" disk (a 96 tpi drive), my 8" disk drives, and RAM disk.

A nice feature of PC-DOS is that it lets you add device drivers which are loaded when the system boots. So additional devices can be interfaced without changing the BIOS code.

#### Editor's Note:

Fred's complete BIOS listing can be downloaded from the Micro C Bulletin Board (503 382-7643) or ordered from Fred directly (on disk for \$15).





## C CODE FOR THE PC

*source code, of course*

|                                      |      |
|--------------------------------------|------|
| Concurrent C . . . . .               | \$45 |
| Coder's Prolog in C . . . . .        | \$45 |
| LEX . . . . .                        | \$25 |
| YACC & PREP . . . . .                | \$25 |
| Small-C compiler for 8088 . . . . .  | \$20 |
| tiny-c interpreter & shell . . . . . | \$20 |
| Xlisp 1.5a & tiny-Prolog . . . . .   | \$20 |
| C Tools . . . . .                    | \$15 |

The Austin Code Works  
11100 Leafwood Lane  
Austin, Texas 78750-3409  
(512) 258-0785

Free shipping on prepaid orders

No credit cards

## TOTAL CONTROL with LMI FORTH™



**For Programming Professionals:**  
**an expanding family of**  
**compatible, high-performance,**  
**Forth-83 Standard compilers**  
**for microcomputers**

### For Development:

#### Interactive Forth-83 Interpreter/Compilers

- 16-bit and 32-bit implementations
- Full screen editor and assembler
- Uses standard operating system files
- 400 page manual written in plain English
- Options include software floating point, arithmetic coprocessor support, symbolic debugger, native code compilers, and graphics support

### For Applications: Forth-83 Metacompiler

- Unique table-driven multi-pass Forth compiler
- Compiles compact ROMable or disk-based applications
- Excellent error handling
- Produces headerless code, compiles from intermediate states, and performs conditional compilation
- Cross-compiles to 8080, Z-80, 8086, 68000, 6502, 8051, 8096, 1802, and 6303
- No license fee or royalty for compiled applications

### For Speed: CForth Application Compiler

- Translates "high-level" Forth into in-line, optimized machine code
- Can generate ROMable code

### Support Services for registered users:

- Technical Assistance Hotline
- Periodic newsletters and low-cost updates
- Bulletin Board System

**Call or write for detailed product information and prices. Consulting and Educational Services available by special arrangement.**

**LMI** Laboratory Microsystems Incorporated  
Post Office Box 10430, Marina del Rey, CA 90295  
Phone credit card orders to: (213) 306-7412

### Overseas Distributors.

Germany: Forth-Systeme Angelika Flesch, Titisee-Neustadt, 7651-1665  
UK: System Science Ltd., London, 01-248 0962  
France: Micro-Sigma S.A.R.L., Paris, (1) 42.65.95.16  
Japan: Southern Pacific Ltd., Yokohama, 045-314-9514  
Australia: Wave-onic Associates, Wilson, W.A., (09) 451-2946

# uniforth™

## ANNOUNCING OUR NEW PRODUCTS

**Sampler (\$35) and/or**

**Professional Systems (from \$175) for ...**

**Apple ProDos**

**Amiga**

**Micro VAX**

**Macintosh**

**IBM PC/AT**

**DEC Falcon**

UNIFORTH is a full-featured, floating-point, FORTH-83 Standard language available for most micro and mini computers.

Call or write for our free catalog or use our Bulletin Board (614-459-7736, 300/1200 Baud) for more detailed information.

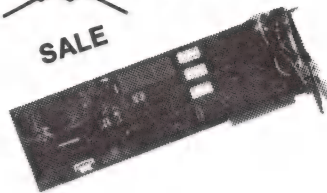
UNIFIED SOFTWARE SYSTEMS  
P.O. Box 21294, Columbus, OH 43221-0294  
(614) 459-7735



# PLUG INTO SAVINGS! FOR YOUR I.B.M.

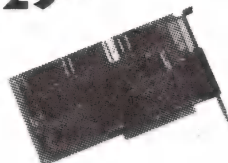
DataMac 5.25" hard disk controller card.

~~\$9995~~ **\$7995**  
**SALE**



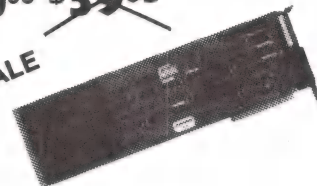
DataMac Dual Async Card (card only)  
comes with one active port, you add the  
second 8250 and connector,  
with documentation

**\$2995**



DataMac Dual Async card with 256K,  
no memory, requires 8250 plus your  
cable for second port.

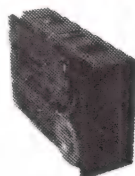
~~\$3995~~ ~~\$5995~~  
**SALE**



## RODIME 20 MEG 5.25" HARD DISK

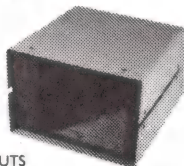
These drives are brand new in factory  
cartons, full size with documentation

**\$29995**  
(similar to photo)



## THE SENSIBLE 5 1/4" DISK DRIVE CABINET KIT

- ☒ FUSED POWER SUPPLY  
5A @ 5V 4.8A @ 12V
- ☒ E.M.I. FILTER, 6 AMP
- ☒ SURGE PROTECTION
- ☒ POWER SWITCH
- ☒ POWER SUPPLY SHIELD
- ☒ CONNECTOR AND FAN CUTOUTS



CONSTRUCTED OF HEAVY GAUGE ALUMINUM, THIS UTILITY DISK  
DRIVE CASE WILL ACCOMMODATE: 5 1/4" HARD DISKS, FLOPPY  
DRIVES, HALF HEIGHTS, FULL HEIGHTS, 2/3 HEIGHTS, CONTROLLER  
CARD AND SINGLE BOARD COMPUTER.  
OVERALL DIMENSIONS 10 1/4" x 10" x 7"  
COLOR IS TAN

ONLY **\$11995**

LESS POWER SUPPLY **\$7995**

## BUSINESS TELEPHONES

STOP PAYING MONTHLY PHONE CHARGES  
These phones are not a cheap import. These are  
the same reliable I.T.T. phones that  
have served us both for many years.

Standard 10 button business  
telephones serviced  
by Bay Telephone Co.

ONLY **\$7995**  
limited to color selection  
on hand



**BRAND NEW 6 BUTTON BUSINESS TELEPHONES**  
ALL THE STANDARD FEATURES INCLUDING BUZZERS AND RINGERS.  
LOOKS THE SAME AS ABOVE PICTURE. COLOR, CHOC. BROWN.

**\$5995**  
ONLY  
(LIMITED QUANTITY)

## GO ON LINE WITH UNITED PRODUCTS

Take advantage of the many items that space does not allow us to advertise. Use  
your computer to download our weekly specials and hard to find items.  
On line 24 hours a day, 7 days a week.  
300 or 1200 baud, even parity, 8 bits with one stop bit.  
The phone number is: (206) 682-5593  
New items are added weekly. Don't miss out, call each week.

## CONTROLLER CARDS



D.T.C. 1403-D (shown with optional software and adaptor)  
control two 8" 851 DSDD and two 8" 1000 type

**\$24995**

D.T.C. 520-1 control four 5.25" DSDD  
and two ST-506 type hard disks

~~\$9995~~ **\$6995** **Closeout**  
Only 10 left

HOST ADAPTER FOR ABOVE CONTROLLERS  
(for most popular Z-80 computers)  
The Winif Adapter and software

**\$5995**

**BUILDING A ROBOT?  
WE CAN HELP!**

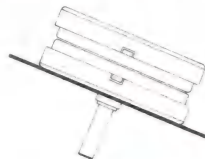
## 12 VDC STEPPER MOTORS

STANDARD 6 LEAD 4 PHASE  
STEP ANGLE: 7.5°  
RESISTANCE PER PHASE: 36 OHM  
SHAFT: 1/4" x 3/8"  
O.D. 1 1/4" x 2 1/4" (3/16" FLANGE)

REG PRICE \$32.00

**\$995** EA.

**\$695** EA. WITH PURCHASE OF ANY STEPPER DRIVER KIT



## UNIVERSAL STEPPER MOTOR DRIVER KITS



FOR DIRECT CONTROL FROM YOUR COMPUTER

- Control almost any stepper motor, forward/  
REVERSE and step sequence.
- For stepper motors rated 1.7 VDC —  
12.0 VDC
- Uses a power supply with an output of  
between 3.0 VDC and 12.0 VDC
- Modifications included for motors rated above  
12.0 VDC
- Inputs/outputs are on a standard 22 pin edge  
card connector (.156 spacing) 4 1/2" x 6 1/2" card,  
G-10 epox.

TECHNA-KIT  
cat.# U.S.M.D.-C

**\$2995**

SAME SPECS. AS U.S.M.D.-C

- except a stand-alone driver
- On board clock (user optional)
- No edge connector

TECHNA-KIT  
cat.# U.S.M.D.

**\$1995**

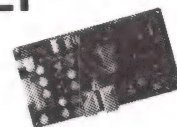
## 3 1/2" FLOPPY DRIVES SHUGART SA300



**\$9995** EA

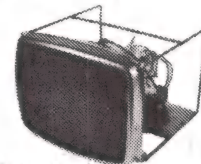
- BRAND NEW
- 500K
- 80 TRACK
- 135 TPI.
- THESE DRIVES GIVE YOU THE SUPER RELIABILITY OF A HARD DISK. THEY  
ARE COMPATIBLE WITH ANY COMPUTER WHICH USES A 1770, 1771, 1791  
OR 1793 CONTROLLER CHIP
- THEY WILL FORMAT SINGLE, DOUBLE OR QUAD DENSITY, DEPENDING  
ON YOUR SOFTWARE.
- XEROX 820 (LITTLE AND BIG BOARD), KAPRO, AMPRO AND LOOK  
ALIKES AND H.P. SINGLE SIDED ARE JUST A FEW OF THE COMPUTERS  
THIS DRIVE CAN BE COMPATIBLE WITH

## SWITCHING POWER SUPPLY



Real Power From a Famous Manufacturer delivers:  
10 amps at 5V, 8 amps at 12V, measures only 8.5" by 4.5" and is only 2.25" thick  
with pinouts **\$3995** (limited supply on hand)

## MONITORS



Ball Brothers TV-120 (shown above)  
16mhz, Xerox 820 compatible, P-4 phosphor B/W, 12"

**\$5995**

Ball Brothers TX-7  
Xerox 820 compatible, 7" flat screen, ant glare for photography

**\$2995 SOLD OUT**

AudioTronics 964-02  
Xerox 820 compatible, TTL/X-Y input, 9" green screen

**\$3995**



**united products, inc.**  
serving the west coast since 1968

1123 Valley Hours: 9-6  
Seattle, WA 98109 Sat. 9-5 PHONE (206) 682-5025

Terms: All orders are shipped F.O.B. Seattle, Wash.  
C.O.D.'s are OK with cash or certified check  
MasterCard and Visa accepted  
On orders over \$50.00 in the continental U.S. we pay the freight.  
All advertised items are subject to prior sale



## Writing Pascal-Style Tools For C

*There is nothing so dear to the hearts of C programmers as tools. Herein, Ron takes on a few goodies like goto(x,y) and a screen clear. But first he covers direct keyboard input, wives, and mistresses. Fun stuff.*

In the last column I discussed some of the dilemmas facing anyone who makes the Hacker's Leap from an implementation of C in CP/M to one running in MS/PC-DOS: buying a compiler, porting your favorite routines over into the 86 universe, facing a whole new gaggle of ways to crash the machine.

This time I'd like to get more down to earth and generate some conveniences that Kaypro-laureates will need once they start slinging useful code on their newer playthings. Even if some of you aren't switching at all, perhaps so far you have shied clear of system-level programming on your PC, and the following short routines may help get you started. The sky's the limit, and there's always the on/off switch to return your system to sanity.

### Direct Character Input

If all you want to use in your programs is buffered input from the keyboard (you know — no entry of characters until the carriage return is whacked), standard `getchar()` will serve your needs, whatever the operating system. But if you're anything like me, writing neat utilities is an addiction; and for that beautiful little utility you dream of showing off to your friends, flashing a response at the touch of a key is an aesthetic fix. For unbuffered input in CP/M, you need to put a simple `bdos(1,0)` call function into your working library:

```
grabchar() { return bdos(1,0);}
```

If you want to avoid echoing on the screen and if your implementation

provides a BIOS function, a `bios(2,0)` call will serve nicely instead. Just don't expect `^C` and `^S` to operate in their normal ways, since you'll be avoiding the CP/M interrupt handlers entirely.

In MS-DOS things get a bit more complicated, in part because that operating system offers many more ropes on which to hang yourself. When MS-DOS was first designed, a good deal of care was taken to give its lowest-numbered BDOS calls the same operations as the comparable functions in CP/M. Thus the listing for `grabchar()` will transfer as is, though the generic function call name may vary with the implementation. Whatever you call it, it's interrupt 21H, service 1.

To obtain unechoed input, you don't really need to move as close to the bare metal as you must on your Kaypro. Just invoke `bdos(8,0)`: Microsoft tossed in some extra goodies to replace CP/M calls not needed on your clone. Unfortunately, service 8 still won't let you use the function keys (F1...F10, Home, PgUp, etc.) in your programs, since these special keys all return an ASCII null on a simple character call.

Actually, all keystrokes on IBM clones return a word, not a byte. In ordinary text input the high bytes are ignored, but the high byte, called the "scan code," is always there for controlling program flow. If the returned

Figure 1 - grabchar Function

```
#include <regs.h> /* or however your implementation handles */
grabchar() /* the registers for interrupt calls */
{
    struct rr regs;
    rr.ax=0; /* service 0 */
    interrupt(0x16,&rr);
    if(rr.ax & 0xff) then return rr.ax & 0xff;
    else switch(rr.ax >> 8){ /*shift scan code to low byte*/
        case 0x53: return 0x1; /*mapping function keys*/
        case 0x54: return 0x2; /*to ^A, ^B, etc.*/
        .....
    }
    /***** and then, somewhere else, the menu: */
    switch(grabchar()){
        case 'a': ...
        case 'b': ...
        case 0x1: ...
        case 0x2: ...
        .....
    }
```

Figure 2 - Service 2

```
gotoxy(row,column)
{
    int row,column;
    struct regs rr;

    rr.ax=0x200; /*2 into AH */
    rr.bx=0;
    rr.dx=0x100*row+column; /*row into DH, column into DL */
    interrupt(0x10,&rr);
    /* the upper corner is (0,0). If you are a Pascal habitue
    and would like to think of it as (1,1), then use "--row" and
    "--column" in the algorithm above. */
}
```



character is a null, then the program knows that a special function key has been hit, and the task is to examine the high byte to see which function key it is.

There are two ways to examine the high byte. MS-DOS function calls 1, 7, and 8 have been designed so that if the character received is a null, the very next call to that function will return the high byte instead. Thus a menu might be constructed to use the special function keys:

```
switch(bdos(1,0)){
  case 'a': ...
  case 'b': ...
  case 0: switch(bdos(1,0)){
    case 0x53: ...
    case 0x54: ...
  }
```

and so forth. If you want to avoid echoing — and echoed scan codes from function keys are rather silly, anyhow — use MS-DOS function 8 instead. Good programming practice, of course, suggests that all those fancy system-dependent functions be gath-

ered up into a single function — e.g., grabchar() — to make the next Hacker's Leap a tad easier.

A direct call to interrupt 16 hex will also do the job, though any time you sally forth beyond interrupt 21 you increase the risk that the program won't run on somebody else's machine. But since prudence is scarcely a trait of C programmers, let's charge straight ahead.

Because the interrupt 16H return is a word in the AX register, we'll get the character and scan code in single call. This time I'll use the function keys and with a bit of mapping retain grabchar()'s single-byte output (see Figure 1).

Such mapping becomes feasible, of course, only if (in this case) ^A and ^B (0x1 and 0x2) are not used separately. The benefit gained is system-independent code. I use this trick so the cursor key code will be the same on my MS-DOS programs and on the CP/M programs for my beloved Kaypro.

Only the definition of grabchar() need be altered in moving back and forth between wife and mistress. (Try explaining that to your better halves whichever they may be.)

## Screen Control

Everybody who writes menus and needs unbuffered input also needs to control the screen display. Writing for the Kaypro makes screen control a breeze. Want to clear the screen? Embed a "\032" (^Z) in a string, and poof! things are scrubbed up and ready to go. A couple of escape codes take me to the row and column of my choice. Though the ANSI.SYS driver does allow similar games with the IBM screen, it's slow and, besides, that's one more darned thing to fill up the memory with. Using Turbo Pascal has gotten me used to calling "clrscr" and "gotoxy" functions, so let's write our own in C and store them in our working library.

To the rescue comes interrupt 10 hex, the video interrupt. Service 2 (Figure 2) sets the cursor at the desired position.

The inverse of this function uses service 3 shown in Figure 3.

Clearing things is almost as easy. Service 10 lets you write a string of characters to the screen, beginning at the cursor position. Therefore writing blank spaces (ASCII 0x20) clears a portion of the screen. That means one could clear the screen entirely by going to (0,0) and writing 2000 (25\*80) blanks, or clear to the end of the screen from the current position, or clear to the end of the line, depending on what number is loaded into the CX or "repeat" register (Figure 4).

Service 10 doesn't change the screen attributes. Service 9 does. If you want to restore the screen after a fling at reverse video or the like, set rr.bx=0xf (or 0x7, if you prefer a dimmer screen) and set rr.ax=0x900 + ' '. Rich folks with color monitors have more complicated choices to make. Obviously, clr() could be written to take another argument or two for fine tuning. With this and the input routines in place, you'll be able to give Peter Norton a run for his money. You just won't get rich and famous doing it at so late a date.

(continued next page)

Figure 3 - Service 3

```
curpos()
{
  struct regs rr;

  rr.ax=0x300;
  rr.bx=0; /*the default screen page */
  interrupt(0x10,&rr);
  return rr.dx; /* row in high byte, column in low.
                  Add 0x101 to the return if you are
                  playing (1,1) games. */
}
```

Figure 4 - Clear Screen Function

```
clr(c) /* 's'=screen, 'l'=line, 'e'=end */
char c;
{
  struct regs rr;
  int cp,x,y; /* storing cursor position */

  op=curpos(); /*get cursor position */
  x = cp & 0xff;
  y = cp >> 8;
  switch(toupper(c)){
    case 'S': gotoxy(0,0); /* 2000 characters on screen */
    rr.cx=2000;
    break;
    case 'E': rr.cx=2000-80*y-x; /* 80 chars to the line */
    break;
    case 'L': rr.cx=80-x;
    break;
    default : return;
  }
  rr.ax=0xa00+' '; /* blank with ASCII 32 string */
  rr.bx=0; /*page again */
  interrupt(0x10,&rr);
}
```



(continued from page 65)

**Addendum: A Nice Find**

Last time I also grumbled awhile about the problem of getting out of a lock-up without zapping the memory of a compatible. If the dead end routine happens to call one of the MS-DOS function calls, a ^C will often break you back to the operating system with all data intact. If it's a closed arithmetic loop or something more exotic, however, the computer just sits there, and sits there, and sits there — while you bang furiously on everything in sight, sounding all the world like some crazed woodpecker.

Of course, there's always ALT-CTL-DEL, but on IBMs and I don't know how many clones, an ALT-CTL-DEL nulls the memory, making recovery of data from working buffers and RAM disks a task leading to tears and/or strong drink. My Zenith, may the Lord be praised, just leaves the higher memory alone, unless the RAM disk is allowed to re-form itself and eat up

the RAM disk file allocation table information.

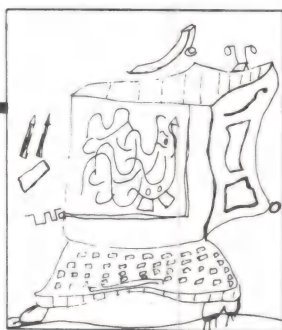
Well, I still don't have the full equivalent of the panic button on the back of my Kaypro, but things have gotten better since I started loading a little (i.e. 128 byte) resident program "uncrash.com" offered in a recent issue of PC Magazine. This little gem uses the clock interrupt to snatch control away from the lock up, testing for a control-Break (not a ^C) and popping you back to the operating system if one is detected. Unless the program itself captures the printer interrupt in weird ways (as do some forms of BASIC), you get a chance to bail out 18 times a second. Many hours and not a few boxes of Kleenex saved.

If the entire keyboard interrupt code has been zapped, of course, no banging on the break key (or on ALT-CTL-Break, for that matter) will catch anybody's attention. Then I still dream of jolly red buttons on the back.

Ninety percent of the time, however,

we C programmers have just forgotten to put in the loop test or have written "greater than" when we really meant "less than." Then the clock interrupt escape route surely helps. Try it; you'll like it. The magazine's listing requires BASIC, so if you're really fastidious, give me a call and I'll let you have a copy of my sanitized COM file. At 128 bytes, it transfers somewhat fast via XMODEM.

■ ■ ■

**C-BUNDLE \$99**

**VIEW:** CRT Based Disk Diagnostic

**EZZAP:** ROM Burning Utility  
includes schematic

**C-PACK:** Utilities in C

**C-Games:** User Modifiable Maze Game

All are written in C, include Source Code, and available separately.

**ICX TOOLKIT**

**ICX:** ISIS to CP/M or MS-DOS exchanger  
for MDS and iPDS each **\$89**

**ISE:** ISIS Emulator for CP/M **\$89**

**C SOURCE CODE****XLT MACRO PROCESSOR w/source ..... 95.00**

XLT can be used as a preprocessor, text translator, or simple cross-assembler, depending on your macro definitions. Comes with manual, C source and macro files.

**Q/C 4.0 CP/M C COMPILER w/source . ONLY 95.00**

Save \$70.00. Fast, full featured compiler from the Code Works includes longs, single-precision floats, excellent manual.

**QC88 C COMPILER FOR PC's w/source ONLY 125.00**

Save \$70.00. As above but no floats or longs. Runs on PC clones.

**QCX C CROSS-COMPILER w/source ..... 495.00**

Runs on PC, generates code fit to run on Z80 CP/M or ROM base controller system.

• Tony Ozrelic's L.A. Software is now KYSO Technology •

**TO ORDER:** Add \$5.00 to total for shipping and handling. Personal check or M.O. are OK. Sorry, no COD's, PO's, or plastic money. 30-day money-back guarantee. Most order shipped 1st class within 5 working days.

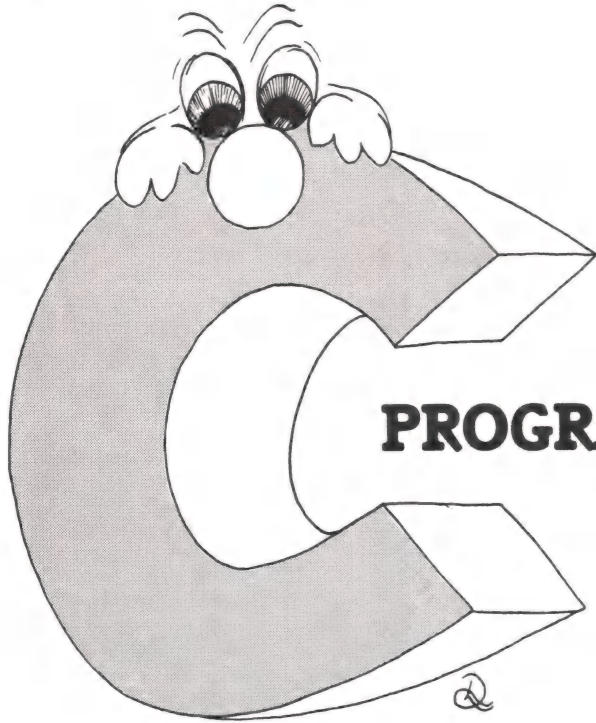
KNOCK YOUR SOCKS OFF

**KYSO**  
TECHNOLOGY

• P.O. Box 5246 • Bend, Oregon 97708 • (503) 389-3452 •



# MICRO CORNUCOPIA'S C CONTEST



## PROGRAMMING CONTEST

If you've been going so hard you just can't C straight, then drop everything, dig out the old compiler, brush off the cobwebs, and C what you can C.

Any kind of C. From Small-C to large, from a hundred lines up, this is your chance to C'ure fame and glory (plus valuable prizes).

### GRAND PRIZE:

- DSI-32, 1 meg, 10 Mhz 32032 computer board with assembler/linker from Definicon Systems  
21042 Vintage St., Chatsworth, CA 91311
- Optimizing C Compiler (large model)  
from Manx Software, Box 55, Shrewsbury, NJ 07701
- Essential Software's C Library  
(graphics, I/O, everything)  
from Essential Software, Inc.  
Box 1003, Maplewood, NJ 07040
- 3 year subscription to Micro C

**SCORING** — The programs will be judged by the Micro C staff on the following:

- 0-15 for ALGORITHM
- 0-25 for CODE ORGANIZATION & READABILITY
- 0-40 for PROGRAM FUNCTION
- 0-20 for USER DOCUMENTATION

### 1st & 2nd Place

- Optimizing C Compiler (large model)
- Essential Software's C Library (graphics, I/O, everything)
- 2 year subscription to Micro C

### 3rd - 5th Place

- Aztec C Prime Package  
(interpreter & compiler)  
from Manx Software
- 1 year subscription to Micro C

----- CONTEST DEADLINE November 1, 1986 -----



## ENTRY FORM

Program Title \_\_\_\_\_

Purpose \_\_\_\_\_

Which C compiler? \_\_\_\_\_ Target system(s) \_\_\_\_\_

Please include source and object files on disk.

### NOTE:

I hereby release this program to the public domain  
and give Micro Cornucopia the right to print the listing.

Signature \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**MICRO CORNUCOPIA**

P.O. Box 223  
Bend, Oregon 97709



# The Racer's Edge Caching And Floating On The 68020

By Trevor Marshall  
(with Sigi Kluger and Chris Jones)

Definicon Systems, Inc.  
21042 Vintage St.  
Chatsworth CA 91311  
(818) 341-5654

*The DSI-32 introduced a lot of us to the world of power computing. I admit it, even though I'm harassed by my family, prodded by my readers, and ignored by my coworkers — when I strap into my black leather anti-g suit and sit down at my 32032 I have power! Pthththththth!*

*When it was introduced just a year ago, the 32032 and its companion floating point processor were the fastest things you could hide in a micro. Now, however, there is something faster (surprise). It comes from Motorola and it resides on two newer, faster, but no more expensive, DSI boards.*

There is something about designing which says you can't do just one. So, ever since we released our 32032 based DSI-32 we've been looking around for our next product.

With the transputer, the 32332, and a number of other interesting chips either coming down the pipe or already trickling out the end, there were certainly some interesting choices.

However, when we looked at the options — reduced instruction set

(RISC) architectures vs. faster, larger versions of the 32032 and 68000; real silicon vs. expectations; fast math co-processors and memory management chips (MMUs) vs. little or no support — we chose the 68020 family.

The 68020 is significantly faster than the 32332 (National's latest version of the 32032). The 68020's math chip, which we will discuss shortly, is more powerful than the 32032's. On the other hand, the 68020's MMU chip (really important for multi-user, multi-tasking environments) is not yet ready for prime time. So there are some trade offs.

## Speed

The 68020 is tremendously fast. To understand why, look at the program in Figure 1.

The 68020 has an instruction cache — 64 tags, each holding four bytes of code. These are the most frequently used pieces of your program.

The cache can't store data because external devices (such as DMA) would have difficulty deciding whether the data you just modified was still in cache or in main memory.

When the CPU asks for an instruction, the cache control logic looks for it

in the cache. If it's not there, it reads it into cache, four bytes at a time, from main memory.

Once the code is in the cache it's flushed only when the cache gets full, and then only after all the other less frequently used locations have been replaced.

Consequently, at any one time, code from all over the memory can be in cache, depending on what your program is using. A frequently used subroutine, for instance, may take up permanent residence in the cache.

## More Cache

The cache is one of two key reasons the 68020 family is so speedy.

When an instruction is found in cache the 68020 takes only ONE CLOCK CYCLE (80ns at 12.5MHz or 60ns at 16.7MHz) to read it to the (pipelined) execution unit. This contrasts with the four clock cycles (including one wait state) for main memory accesses.

We added a jumper to the DSI-020 so you can turn this cache off.

Photo 1, taken with the cache disabled, shows the bus activity during the loop from MOVIT to the branch, which occurs three instructions later.

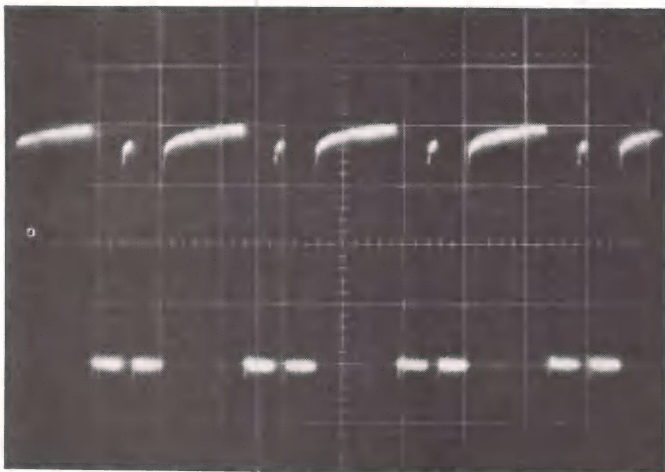


Photo 1 - Cache Off

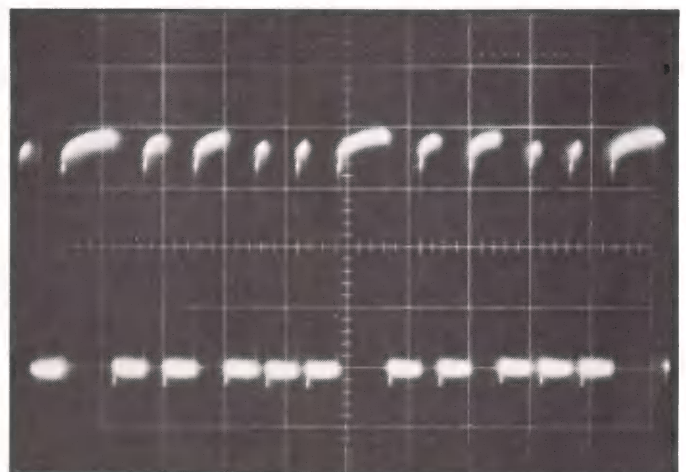


Photo 2 - Cache On



When the (address strobe) signal is low then the CPU is reading from main memory (240ns each time). When it's high the instruction is being processed (80ns plus).

The reference point (after the BRANCH instruction) is followed by the read of the indirect register to register move opcode.

This is followed by the fetch from "A0" and the store to "A1". The SUBQ executes internally very quickly (and so only one clock elapses between the final two accesses).

The scope is set to 500ns per division so the total loop time is approx 2.3us. Photo 2 shows the bus activity when the cache is working. Note that the entire program easily fits within the cache, so only data is fetched from main memory.

The first thing to notice is that the total loop execution time is now only 1.2us. The second thing is that the two data fetches are closer together. This is because the CPU is pipelined internally. Since it doesn't have to go out to the bus to get the opcode, instruction execution is faster.

The 68020 is the first microprocessor with a cache. The cache gives it blinding speed for things like integer operations (2 to 3 times a VAX 11/780) — much faster than the 32032 or the 32332. The Sieve of Eratosthenes takes less than 0.9 seconds on the 16.7MHz 68020. (Editor's note: Makes it kind of hard to time the standard benchmarks, doesn't it?)

### Floating Along

The second difference between the speed of the 32032 family and the 68020 is the 68881 floating point processor. A number of DSI-32 users complained that the 32032 was only 2 or 3 times faster than their AT, not 10 as the benchmarks suggested. The reason is simple. The 32081 floating point unit, although many times faster than the 8087/80287, only performs the primitive  $+/-/*$  operations.

Functions such as COS, SIN EXP, or LOG have to be performed by a software subroutine. The 8087/80287 has these partially coded in hardware, and thus they execute them more quickly.

The 68881 floating point unit not only performs the basic arithmetic at high speed but also all the commonly used mathematical functions. In addition, they're calculated internally to 80-bit accuracy.

### Numbers

The 68020 family does over a million single-precision whetstones. At 1067K, the 16.7MHz DSI-780 is almost as fast as the VAX 11/780 (1152K). IBM's super-fast PC-RT plods along at 200K. (What a delight it is to have that machine as a competitor!)

Since all calculations are performed to 80-bit accuracy, the 68020 easily outpaces the VAX 11/780 on the double precision whetstones (at 902K per second).

(continued next page)

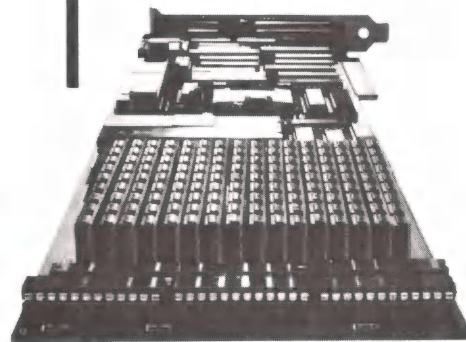
Figure 1 - Byte Transfer Program

```

;      TEST PROGRAM
;      THIS PROGRAM CONTINUOUSLY MOVES 458,752 BYTES FROM
;      ONE LOCATION IN MEMORY TO ANOTHER.
;
;      ORG      $00004000
;
START:  MOVE.L   #$8000,A0          ; SOURCE ADDRESS
        MOVE.L   #$8000,A1          ; DESTINATION ADDRESS
        MOVE.L   #114688,D0         ; COUNT
LOOP:   MOVEM.L  D0/A0/A1,-(A7)      ; PUSH REGISTERS
        MOVIT:   MOVE.L   (A0)+,(A1)+ ; MOVE 4 BYTES AT A TIME
        SUBQ.L   #1,D0              ; DECREMENT COUNTER
        BNE.B    MOVIT              ; LOOP UNTIL DONE
        MOVEM.L  (A7)+,D0/A0/A1     ; POP REGISTERS
        BRA.B    LOOP              ; AD NAUSEAUM
        END

```

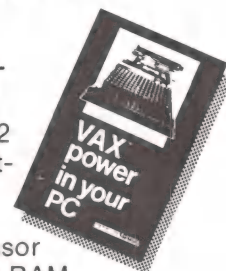
# VAX<sup>TM</sup> power in your PC



for less than  
**\$1500**

### FREE BOOKLET

- 10MHz 32032 CPU no-wait-states
- Floating point processor
- 1MB to 8MB RAM
- Virtual memory with MS-DOS and UNIX<sup>TM</sup>



VAX is a trademark of Digital Equipment Corp. UNIX is a trademark of AT&T Bell Laboratories.

**DEFINICON SYSTEMS**  
INC

31324 Via Colinas, Suite 108  
Westlake Village, CA 91362 USA  
(818) 889-1646 Telex: 272849 DSI UR

**(818) 889-1646**



(continued from page 69)

(The whetstone is a floating-point benchmark written in the late 60s by a fellow named Curnow. Whetstone programs are available in the public domain for CP/M and MS-DOS systems. The program "dhrystone" is an integer variation.)

### Details

The DSI-020 and DSI-780 both use an IBM-PC/XT/AT as the disk, file, and console I/O system. (Those of you who can't compromise your principles should consider an X16, XT-186, or Challenger XT to use as a base.)

Both DSI boards use an auto-sensing AT/XT bus connector that adjusts to

the 8- or 16-bit bus (with 16 bits you gain 10 percent on disk I/O).

The DSI-020 has 1 Meg of memory (although Micro C will no doubt tell you hackers how to expand it to 2) and a 12.5MHz chipset (only gives 770K whetstones, sorry). You can purchase it, assembled and tested, for the price of the DSI-032 starter kit.

Parity and serial ports are a little extra. The DSI-780 is the up-market product, with a 16.67MHz chipset and 4 Meg of 256K RAM (expandable to 16 Meg of 1 megabit RAMs) on the motherboard. (Editor's note: Hold on there, we just got through discussing how we could make a winchester look like 15 Meg of RAM because no one in their right mind would put 15 Meg of

real RAM into a micro. Would they????)

### Compilers

The compilers are from Silicon Valley Software this time. Although a little slower than Green Hills, they are more complete and have much better manuals. (The Pascal even comes with strings!) The FORTRAN is ANSI-F77, not derived from UNIX.

Lattice Logic (of Great Britain) has supplied their ANSI level 1 Pascal and C. The Living Software (also G.B.) BASIC-C converter complements the SVS BASIC interpreter. QUELO supplied a low-cost assembly language development system.

The operating system kernel func-

Figure 2 - Copy Program

```

COPYF  IDNT  1,0          ; VERSION 1.0
;
; THIS SAMPLE PROGRAM COPIES ONE FILE. IT SHOULD BE
; CALLED WITH TWO ARGUMENTS, THE SOURCE AND DESTINATION
; PATHNAMES. FILES MAY BE OF ANY SIZE AND TYPE.
; WRITTEN BY S. KLUGER, DEFINICON SYSTEMS INC.
;
; ORG  $00004000          ; STANDARD DSI-020 ORIGIN
;
; START: MOVE.L 8(A7),D0    ; GET ARGC PASSED ON STACK
;         MOVE.L 4(A7),A0    ; GET *ARGV PASSED ON STACK
;         CMPI.W #3,D0       ; MUST BE 2 ARGUMENTS
;         BNE.W ERRORA      ;
;         MOVEA AO,A5        ; SAVE *ARGV
;         MOVE.L #COPY1,A0   ; SAY, "COPYING "
;         BSR.W PRINTS
;         MOVE.L 4(A5),A0    ; GET FILENAME PTR INTO A0
;         BSR.W PRINTS      ; PRINT SOURCE FILENAME
;         MOVEQ #5,D0        ; OPEN REQUEST
;         MOVEQ #0,D1        ; READ MODE
;         TRAP #14
;         CMPI.W #$FFFF,D0   ; IF FILE NOT FOUND
;         BEQ.W ERRORI      ; THEN ABORT WITH ERROR
;         MOVE.W D0,INHDL    ; STORE INPUT HANDLE
;         MOVE.L #COPY2,A0   ; SAY, " TO "
;         BSR.W PRINTS
;         MOVE.L 8(A5),A0    ; GET DESTINATION FILENAME
;         BSR.W PRINTS      ; DISPLAY IT
;         MOVEQ #7,D0        ; CREATE OUTFILE
;         TRAP #14
;         CMPI.W #$FFFF,D0   ; ERROR IF CANNOT CREATE
;         BEQ.W ERRORO      ; STORE OUTPUT HANDLE
;         MOVE.W D0,OTHDL    ; POINT TO RAM BUFFER
;         MOVE.L #BUFFER,A0  ; GET INPUT FILE HANDLE
;         MOVE.W INHDL,D1    ; READ REQUEST
;         MOVEQ #8,D0        ; READ UP TO 512K
;         MOVE.L #80000,D2
;         TRAP #14
;         TST.L D0           ; IF WE READ ZERO BYTES
;         BEQ.W DONE        ; THEN WE MUST BE FINISHED
;         MOVE.L D0,D2       ; ELSE MOVE ACTUAL BYTE COUNT
;         MOVE.W OTHDL,D1    ; GET OUTPUT HANDLE
;         MOVEQ #9,D0        ; DO A WRITE
;         TRAP #14
;         BRA.B LOOP        ; NOW GO GET MORE
;
; DONE:  MOVE.W OTHDL,D1     ; GET OUTPUT FILE HANDLE
;         MOVEQ #6,D0        ; CLOSE IT
;         TRAP #14
;         CLR.W D0
;         RTS               ; NOW, BACK TO OPERATING SYSTEM
;
; ERRORA: MOVE.L #MERRA,A0
;         BRA.B ERROR
;
; ERROR: MOVE.L #MERRD,A0
;         BRA.B ERROR
;
; ERRORR: MOVE.L #MERRR,A0
;         BRA.B ERROR
;
; ERRORI: MOVE.L #MERRI,A0
;         BRA.B ERROR
;
; ERRORO: MOVE.L #MERRO,A0
;         MOVEQ #1,D0        ; USE "BDOS" CALL FOR ERROR MESSAGES
;         MOVEQ #9,D1
;         TRAP #14
;         CLR.W D0
;         RTS
;
; THIS ROUTINE COPIES THE NULL-TERMINATED STRING AT (A0)
; TO "STDOUT" (DISPLAYS IT ON THE SCREEN)
;
; PRINTS: MOVE.L AO, -(A7)   ; SAVE STRING POINTER
;         PS.L: TST.B (A0)    ; SEE IF AT END
;         BEQ.B _X           ; DONE IF END OF STRING
;         MOVEQ #1,D1        ; STDOUT = HANDLE 1
;         MOVEQ #1,D2        ; ONE BYTE ONLY
;         MOVEQ #9,D0        ; WRITE REQUEST
;         TRAP #14
;         ADDQ.L #1,A0       ; POINT TO NEXT BYTE
;         BRA.B PS.L        ; AND LOOP
;
; _X:     MOVE.L (A7)+,A0    ; POP STRING POINTER
;         RTS               ; RETURN TO CALLER
;
; MERRA:  DC.W $0DOA
;         DC.W 'USAGE: LOAD COPYF INFILE OUTFILE'
;         DC.W ' (FULL PATH OK)', $0DOA, '$'
;
; MERRD:  DC.W $0DOA
;         DC.W 'ERROR DELETING FILE', $0DOA, '$'
;
; MERRR:  DC.W $0DOA
;         DC.W 'ERROR RENAMING FILE', $0DOA, '$'
;
; MERRI:  DC.W $0DOA
;         DC.W 'ERROR OPENING INPUT FILE', $0DOA, '$'
;
; MERRRO: DC.W $0DOA
;         DC.W 'ERROR CREATING OUTPUT FILE', $0DOA, '$'
;
; COPY1:  DC.W $0DOA
;         DC.W 'COPYING ', 0
;
; COPY2:  DC.W ' TO ', 0
;
; INHDL:  DC.W 0            ; INPUT FILE HANDLE
;         OTHDL: DC.W 0      ; OUTPUT FILE HANDLE
;
; BUFFER: DC.B 0            ; START OF BUFFER
;         END

```



tions have been expanded and improved, building on our DSI-32 experience. Sigi Kluger has provided a number of new operating system hooks to ease assembly language programming.

### Using The 68020

Figure 2 shows a simple program to copy an MS-DOS file to another, using the 68020.

When the program execution begins, the kernel has sized the memory, allocated a stack at the top of it, placed ARGV and a pointer to ARGV on it, and set up a system return address for use at program completion. An RTS (viz, RET) instruction will return to the operating system (MS-DOS) with the value in D0 returned as a program return parameter. This parameter may be conditionally tested in an MS-DOS batch stream.

The operating system is accessed via the TRAP #14 instruction.

The file system uses the MS-DOS (XENIX-like) disk I/O functions to ease the interface to high level languages.

When you OPEN a file, a HANDLE is returned, which is used to identify subsequent accesses to that file. This saves having to point to an opened FCB all the time. The data buffer size is 512K.

This program (on a Taiwanese PC-AT clone) takes 2.47 seconds to copy a 123K file.

Note that the ERROR: subroutine uses a BDOS call (#9, print a string) to output its messages.

### Summarizing

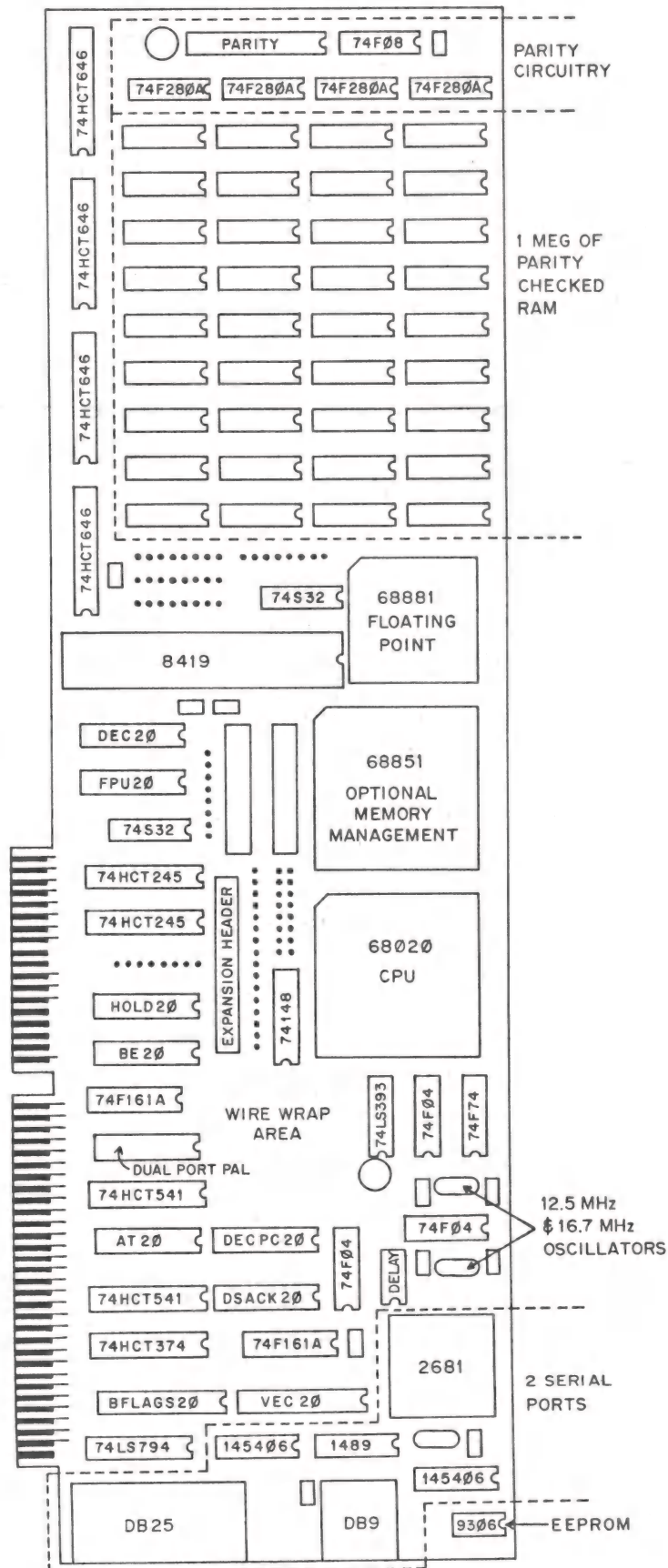
The DSI-020 represents second generation 32-bit technology. The 68020 family represents technology that is unequalled in silicon today.

The 32332, although significantly faster than the 32032, is not as fast as the 68020.

If UNIX is your operating system, then continue to use the National family. Motorola's UNIX is still too expensive and their MMU is not bug free. If absolute performance is your goal, then go for the 68020 — it'll be some time before this family can be beaten.

See you all at SOG.

Layout of  
68020  
Co-processor





# Split Personalities

## The V Series (20-70) & The 80386

By Dean Klein

904 N 6th St.  
Lake City MN 55041

*NEC has shown that it can take the latest features of the 80186, add 8088/8086 pin compatibility, an 8080 instruction set, some new instructions, and put it all together in a low-power CMOS package. Super!*

*However, what about NEC's new V40, V50, V60, and V70? What are they? Are they winners, or is NEC having trouble making product decisions when it's leading instead of following?*

**S**chizocentral processing unit is. What is it? It's the latest — a family of processors with split personalities, i.e. dual instruction sets.

NEC's family name begins with "V"; the V20 and V30 were the first members. Two are just out — the V40 and V50 (with integrated peripherals much like Intel's 80188 and 80186); and two more are announced — the 32-bit V60 and V70.

Intel's latest baby is also 32-bit, the 80386, and it, too, falls in with this split personality group, designed for compatibility with previous Intel chips.

### V20, V30, V40 & V50

The V20 and V30 are pin compatible with the Intel 8088 and 8086. And the V20 and V30 can, in most cases, replace their counterparts.

The V40 and V50 cannot. Although they have integrated peripherals (like the 80188 and 80186), they ARE NOT pin compatible.

All of the NEC V series processors have been built (using the CMOS process) to consume less power and to operate cooler. One undesirable effect of this is a slightly diminished bus drive capability which can cause problems in some PC clone boards.

### Improved Microcode

Most CPUs use microcode (a low level translator) to implement machine code instructions.

The execution unit obtains an instruction and decodes it to determine the appropriate set of microcodes to use. Think of this decoding as a breaking down of instructions into classes of instructions.

The microcode then further differentiates the instructions by looking at the various fields within the instructions which specify the instruction operands (e.g. memory location or register type).

Microcode then controls the transfer (and path) of operands from source to destination. For example —

`ADD AX, BX`

moves the contents of register AX and BX to the ALU where they're added. The results are put (returned) in the AX register.

Intel and NEC saw the faults of the 8088/86 microcode and improved the microcoding in their later chips. The V series and the 80186/188/286 have similar, speedier microcode.

### Effective Address Calc

As I mentioned in an earlier Micro C (Issue 27), the effective address calculation has been sped up by dedicated hardware adders. This lets address calculation proceed while an instruction is executed, saving several clock cycles.

### New Instructions

The V series and the 80188/80186 share new instructions, except for a few V series goodies like bit manipulation instructions and BCD string functions.

The new bit manipulation instructions allow setting, clearing, and complementing individual bits in registers or memory. These instructions are similar to the Z80 instructions for bit operations. The new mnemonics are:

`SET1, CLR1 and NOT1`

Two new bit field instructions, INS and EXT, allow bit operations on strings of bits made up of bit fields.

Bit fields are variable length data structures from 1 to 16 bits long. They're pointed to by ES:DI:reg8, where reg8 is any byte register or an immediate value.

The INS (insert) instruction moves data from AX to the destination string. The EXT instruction extracts data from the source bit string and puts it in AX.

The 8086 family is somewhat lacking in the BCD arithmetic department, so NEC added new instructions for operating on BCD strings of 1 to 254 digits or as BCD bytes.

The new ADD4S, SUB4S and CMP4S instructions add, subtract, and compare BCD strings. The pointer to the source string is DS:SI; the pointer to the destination string is ES:DI.

Two BCD rotate instructions are useful for unpacking and packing BCD digits. ROL4 and ROR4 rotate the operand one digit.

### The Alternate Instruction Set

In emulation mode the V series processors can execute two complete instruction sets — its own and the 8080's.

Emulation mode is initiated by setting the mode flag in the program status word (also known as the flag register, or PSW). The special instruction, BRKEM, sets the flag.

In 8080 emulation mode the processor registers are used differently —

| 8080 register | Vx0 register |
|---------------|--------------|
| =====         | =====        |
| A             | AL           |
| B             | CH           |
| C             | CL           |
| D             | DH           |
| E             | DL           |
| H             | BH           |
| L             | BL           |
| SP*           | BP*          |
| PC**          | IP**         |

\* Stack pointer

\*\* Instruction pointer

The use of BP as a stack pointer allows the 8080 program to keep a



separate stack (other CPU registers are inaccessible to the program).

When interrupts occur the processor saves the machine state on the main stack and executes the interrupt handler in native (8086) mode.

The 8080 code can also call native mode interrupt handlers by using a special instruction, CALLN. 8080 mode can be abandoned with the RETEM instruction.

### Integrated Peripherals

The NEC designers built a winning peripheral set into the V40 and V50, similar to the Intel 80188 and 80186, but superior for most applications.

These peripherals include an 8253/4 compatible timer counter, an 8259A compatible interrupt controller, a serial port similar to the 8251, and a good DMA controller. RAM refresh is also built into the V40 and V50.

The serial port is limited in some applications because it lacks the synchronous modes of the 8251. Another more serious limitation is a shortage of pins, which forces some sharing between peripherals. For example, the serial port Receive Data pin is shared with the DMA Request Input, DRQ3. Similarly, TxD and DACK3 share.

Interestingly, the parts are also offered in packages with more pins, but the designers still didn't separate these signals.

The V40 and V50 DMA controller has four channels, and each channel has its own DRQ and DACK pins, making it superior to the 80188/186's.

The DMA controller is compatible with NEC's existing stand-alone DMAC, the 71071. This controller provides a full 20-bit address (unlike the 8237 used in the PC).

The availability of separate DRQ and DACK lines allows the DMA controller to transfer data directly between the requesting peripheral and memory, rather than first reading the data from the source and then writing it to the destination (80188/186 style). This allows for data transfers up to twice as fast as the 80188/186 DMA.

### Applications For The V

The V20 and V30 can directly replace the 8088 and 8086 in most cases, adding a substantial boost in speed. A side benefit is the enhanced instruc-

tion set as well as 8080 emulation mode.

However, the V40 cannot replace any existing processor. Its saving grace is that its chip peripherals are similar to those in an IBM PC. The interrupt controller is identical to the PC's as well as the timer counter. The DMA controller and serial port aren't compatible.

The addresses of the V40 on-chip peripherals can be programmed to match the PC's. The base address of the peripherals is set to a 256-byte block by writing to an internal CPU register. The offset of each peripheral is then set by writing to a register for each device.

The DMA controller can be used to provide enhanced functions such as SCSI and networking, functions which aren't found in the standard IBM PC.

I must admit I was really excited after reading the V30 data sheet (just ask my wife). I thought, "If the V30 is this close to being 'just right,' the V40 must be perfect." Then NEC let me down — the peripherals aren't really integrated; they're external to the chip.

The big difference is that the V30 (and the IBM PC) uses address line A0 to access peripheral registers. The V40 starts with A1.

Recall that the V40 bus is 16-bit and the V30's is 8. This slight difference means no integrated peripherals can be used to replace those in a PC compatible design.

Despite it all, the V40 is still superior to the 80186. But would I use it? Probably not, unless 8080 mode becomes an absolute requirement.

While the V40 is built only by NEC, the 80186 has several manufacturers, which helps drive the price down. And there's a lawsuit pending against NEC. Intel's charging that NEC has copied their microcode in the V series.

### The 80386

Intel's late entry into the 32-bit CPU arena is the 80386, which maintains compatibility with the 8086 while adding many features, new instructions, new registers, and an improved memory management scheme.

The 80386 operates in either of three modes — Real Address, Protected Virtual Address, and Virtual 86.

In Real Address mode the 80386 looks like an 8086 to the program, except for several new instructions and two new segment registers. The total address space in this mode is 1M bytes (same as in the 8086).

The new 80386 instructions are dedicated to bit manipulation. The BT instruction tests a bit; BTS tests and sets a bit; BTR tests and resets a bit; and BTC tests and complements a bit.

In addition, even enormous bit strings of up to 4G bits long may be defined and manipulated. IBTS inserts a bit string; XBTS extracts a bit string; BSF scans a bit string; and BSR scans it in reverse.

The bit instructions are useful for bit-mapped graphics operations.

When the 80386 is reset the processor automatically performs extensive on-chip diagnostics which test as much as 85 percent of the chip. The results are returned as the contents of the processor registers and can be tested by the boot program.

### 80386 Real Address Mode

After reset the 80386 is in Real Address mode. All registers are 16 bits long, as in the 8086. The bus width can be 16 or 32 bits wide and selected on a cycle by cycle basis.

The Bus Interface portion of the 80386 checks an input, BS16, late in the bus cycle to determine if the operation run on the upper half of the data bus needs to be run again. This signal can be permanently strapped to either bus size as well.

### 80386 Protected Address Mode

The 80386 and 80286 Protected modes are compatible, with up to four privilege levels of protection for different tasks (such as operating systems and application programs).

Two restrictions which plagued earlier Intel 16-bit CPUs may be removed in protected mode: program size and segment size.

Since protected mode is a virtual memory mode, the program size can be as much as 64 Terabytes (virtually infinite). The physical address space is 4G bytes, and the segment size may be set up to 4G bytes as well.

*(continued next page)*



(continued from page 73)

The split personality of the 80386 is subtle and can only be found in protected mode.

The architects of the 80386 wanted their CPU to be upwards compatible with the 80286 and true 32-bit. So they created a 'D' bit flag in a processor register to tell the processor its operand size default.

If D=0, the registers and operands default to 16 bits (like the 80286). To override this default width use an instruction prefix.

For 32-bit mode, set the D bit. This happens when the CPU switches tasks, and a new Code Segment Descriptor is loaded.

In 32-bit mode there are 8 new registers — EAX, EBX, ECX, EDX, ESI, EDI, EBP, and ESP.

In the 80386 assembly language a WORD is still 16 bits and a DWORD is 32 bits, making the transition from 8086 assembly language almost painless.

In protected mode the 80386 can calculate the effective address either from 16-bit components or from 32-bit components. The default again is supplied by the D bit.

An example of effective address calculation would be an instruction which calculates the offset of an array element using a CPU register as a pointer. The default effective address size can be overridden either way by the Effective Address Size Prefix to an instruction.

This system of having default operand and EA sizes is very flexible and allows each CPU task to default to the appropriate condition. The availability of an easy override further enhances the system.

## Virtual Mode 86

The major obstacle to the acceptance of the 80286 protected mode has been that once protected mode is entered, the usage of the segment registers changes sufficiently that the CPU can no longer run most programs written to run in Real mode. Thus the IBM PC/AT isn't allowed to operate at peak efficiency for multi-tasking. The 80386's Virtual Mode 86 (VM86) addresses this problem.

In VM86 the processor behaves just

as in Real Address mode except that the Memory Management Unit manages program addresses.

The program still sees a logical address space of 1M. The actual physical address isn't important. The operating system can have several VM86 tasks in memory simultaneously and switch between them and 32-bit applications at will.

Several types of instructions are trapped when executing in VM86 mode. All input and output instructions and any instructions which attempt to affect the interrupt mask flag can be trapped. Software interrupts and instructions relating to protected mode operation, too, can be trapped. Trapped instructions are summarized below:

```
INS, IN, OUTS, OUT    ;optionally
                      ;trapped if
                      ;IOPL<3
STI, CLI, PUSHF, POPF, IRET, INT n
```

IOPL is the task's IO Privilege Level and is set by the operating system when the VM86 task is entered.

## 80386 Memory Paging

Demand paged virtual memory is implemented in the 80386 CPU as an optional extension of the 80286 memory management scheme.

The page size is fixed at 4K bytes. Paging is designed to be managed by the operating system. Each page has several flags associated with it that tell the operating system whether it is a candidate for swapping out or rewrite.

A page has an Accessed flag that tells the processor the page has been read or written. By periodically reset-

ting this bit the OS can determine whether or not the page has been used recently. If not, the page is a good candidate for freeing, since pages that haven't been used recently are less likely to be used in the near future. The page also has a Dirty Flag which tells the OS the page has been written to and must be saved.

To speed the paging operations the page table entries for the most recently accessed pages are cached by the processor in a special Translation Lookaside Buffer. Additional page table entries are stored in memory. If a task attempts to access a page which isn't present, an exception occurs which allows the operating system to get the missing page.

## 80386 Applications

The 80386 will likely find a home in many PC/AT type designs. In the simplest of these, the bus size can be strapped as 16 bits, making the 80386 a drop in replacement for the 80286 (not pin compatible, however).

With a good design, these PC/AT types should be up to three times faster than the IBM PC/AT, since the initial processor speed offered from Intel is 12.5MHz to 16MHz.

The true power of the 80386 won't be released until a good operating system is written to support it. That operating system might even run PC-DOS as a VM86 task.

Less dependence on hardware compatibility with older machines might allow a high performance workstation to be built which could take advantage of many already available higher performance peripherals. These include DMA, video and disk controllers,

# THE COMPUTER JOURNAL

## Practical Programming & Hardware Projects

The Computer Journal is published bimonthly for those interested in programming their computers, interfacing to peripherals, and hardware construction.

Now expanded with in-depth articles covering Turbo Pascal, "C", Assembly Language, Kaypro, Ampro, Interfacing, plus CP/M and other operating systems.

6 Issues (1 year) \$14 in US — VISA & MasterCard accepted  
190 Sullivan Crd., Columbia Falls, MT 59912 (406) 257-9119



communication devices, and parallel processors, all better than currently used devices.

Fast multi-tasking with a high resolution video system and windowing sound good to me. I'd like to be able to fly Flight Simulator in one window while I'm working in several others. (Editor's note: Make sure one of those other windows has a good autopilot or you might crash the system.)

#### The V60 & V70

Yes, there's more. NEC has announced two new 32-bit processors to compete with the 80286 and 80386. The native mode instruction set isn't compatible with the 8086, however. And it probably isn't compatible with the 80386 either. Compatibility with the 8086 is provided by leaving 32-bit mode and entering what NEC calls Emulation Mode. It isn't clear whether there's 8080 emulation.

One interesting feature of these processors is on-chip floating point support. This has the advantages of minimizing the support circuitry required and standardizing the program interface, but has the disadvantages of poorer performance, lower precision and fewer operations.

The V60 and V70 don't have dynamic bus sizing (like the 80386). Instead the V60 has a fixed 16-bit bus, and the V70 has a fixed 32-bit bus.

#### V60 & V70 Applications

The success of these processors is probably going to be inversely proportional to the success of a good operating system for the 80386. It isn't clear whether these processors have the important 80386 VM86-like mode.

One possible application might be as a graphics engine where the on-chip floating point and bit manipulation instructions could be effectively used for graphics operations. We'll have to wait for more details in order to reach a verdict.



#### XT CLONE COMPLETE SYSTEMS

MOTHERBOARD WITH 640K INSTALLED  
150 WATT POWER SUPPLY FLIP TOP CASE  
AT STYLE KEYBOARD COLOR GRAPHICS VIDEO  
SERIAL PORT PARALLEL PORT REAL TIME CLOCK  
FLOPPY DISK CONTROLLER  
TWO FLOPPY DISKS \$750.00

ABOVE WITH ONE FLOPPY AND 20 MEG HARD DRIVE  
\$1175.00

TESTED AND ASSEMBLED WITH ONE YEAR GUARANTEE

KEYBOARD (MICROSWITCH) 113 KEYS 8 BIT ASCII  
PARALLEL OUTPUT WITH CASE  
AND COMPLETE DOCUMENTATION \$40.00

SA800-2 DISK DRIVE CLEAN - USED \$59.00  
SA850 DISK DRIVE CLEAN - USED \$99.00  
STANDARD MOUNTING - GUARANTEED 60 DAYS

CABINET FOR ABOVE HOLDS TWO DRIVES  
POWER WIRING COMPLETED (AC AND DC)  
FAN AND INPUT AC WIRING DONE  
20 X 9 1/2 X 17 DEEP  
ALL MOUNTING HARDWARE  
POWER SUPPLY FOR TWO DRIVES (SWITCHING)  
WILL POWER DRIVES AND SBC 6 X 8 X 2 1/2  
5VDC @ 8 AMPS, +12VDC, -12VDC, -5VDC @  
.5 AMPS EA AND 24VDC @ 2 AMPS  
CABINET AND POWER SUPPLY TOGETHER \$100.00

HARD DRIVE  
20 MEG RODIME HARD DRIVE  
8 HEADS 320 CYLINDERS  
6 MONTH GUARANTEE \$310.00  
CONTROLLER FOR RODIME WITH CABLES \$125.00

XT CLONE PARTS ONE YEAR GUARANTEE  
MOTHERBOARD TURBO (6.67 AND 4.77 MHz) \$145.00  
MOTHERBOARD UP TO 640 K ON BOARD \$125.00  
COLOR GRAPHICS CARD \$ 75.00  
FLOPPY DISK CONTROLLER UP TO 4 DRIVES \$ 40.00  
HARD DISK CONTROLLER \$125.00  
DISK I/O CARD - FLOPPY DISK CONTROLLER  
RS-232 CLOCK PARALLEL GAME ADAPTER \$110.00  
CASE FLIP TOP STYLE \$ 45.00  
POWER SUPPLY 150 WATT \$ 75.00  
KEYBOARD AT STYLE \$ 59.00

QUME 142 HALF-HEIGHT FLOPPY DRIVE  
IBM COMPATIBLE (LIMITED SUPPLY) \$ 89.00

CASCADE ELECTRONICS  
ROUTE 1 BOX 8  
RANDOLPH MN 55065  
507-645-7997

FREE  
SHIPPING  
ON PREPAID ORDERS

COD ADD \$3 CREDIT CARD ADD 5% MN ADD 6%  
LIMITED TO STOCK ON HAND EVENING CALL OK



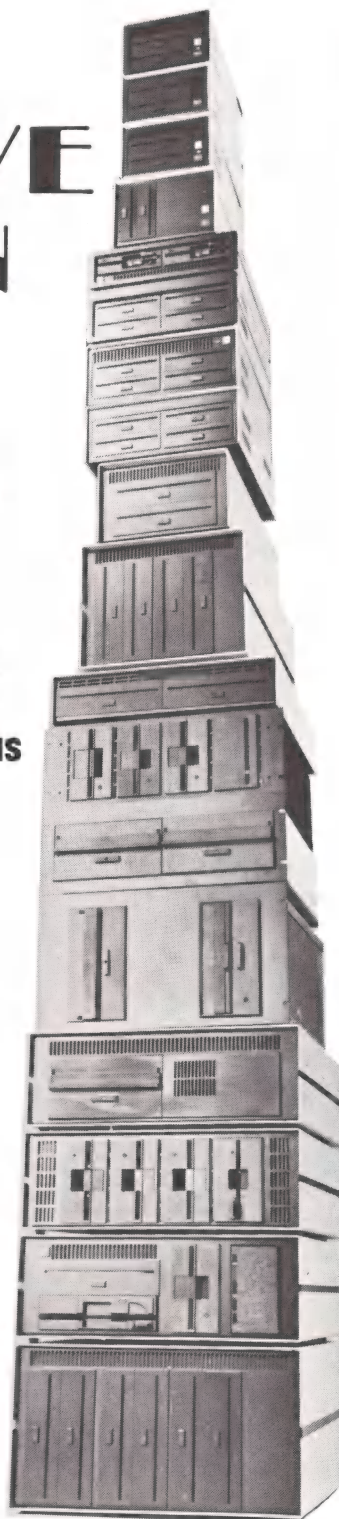
# DRIVE INN

Enclosure &  
power supplies  
for  
**FLOPPY,  
WINCHESTER,  
TAPE DRIVES,  
SINGLE BOARD  
COMPUTERS  
& S-100 SYSTEMS**

8 inch  
5 inch  
3 inch

**CUSTOMIZING  
AVAILABLE**

Call or write  
for free  
catalogs &  
application  
assistance



## INTEGRAND

RESEARCH CORPORATION

8620 Roosevelt Ave. • Visalia, CA 93291  
209/651-1203

TELEX 5106012830 (INTEGRAND UD)  
EZLINK 62926572

We accept BankAmericard/Visa  
and MasterCard

## CACHE22 + CP/M 2.2 = CP/M Max!

CACHE22 is a front-end system program that buries all of CP/M 2.2 in banked memory. It helps 8080/Z80 computers to survive by providing up to 63.25K of TPA, plus the ability to speed disk operations, eliminate system tracks, and run Sidekick-style software without loss of transient program space. Complete source and installation manual, \$50.00.

CP/M is a trademark of Digital Research Inc.  
Sidekick is a trademark of Borland International



**MIKEN OPTICAL COMPANY**

53 Abbett Avenue, Morristown, NJ 07960  
(201) 267-1210

## ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)  
QUANTITY ONE PRICES SHOWN

OUTSIDE OKLAHOMA: NO SALES TAX

640 Kbyte MOTHERBOARD KITS: Zenith 150: \$87.46  
IBM PC/XT, Compaq Portable & Plus; hp Vectra

| DYNAMIC RAM |        |        |         |
|-------------|--------|--------|---------|
| 256K        | 64Kx4  | 150 ns | \$4.85  |
| 256K        | 256Kx1 | 100 ns | 5.95    |
| 256K        | 256Kx1 | 120 ns | 3.90    |
| 256K        | 256Kx1 | 150 ns | 3.47    |
| 128K        | 128Kx1 | 150 ns | 4.92    |
| 64K         | 64Kx1  | 150 ns | 1.60    |
| EPROM       |        |        |         |
| 27512       | 64Kx8  | 250 ns | \$29.00 |
| 27C256      | 32Kx8  | 250 ns | 8.15    |
| 27256       | 32Kx8  | 250 ns | 5.45    |
| 27128       | 16Kx8  | 250 ns | 3.90    |
| 27C64       | 8Kx8   | 200 ns | 5.30    |
| 2764        | 8Kx8   | 250 ns | 3.80    |
| 2732        | 4Kx8   | 450 ns | 3.85    |
| STATIC RAM  |        |        |         |
| 6264LP-15   | 8Kx8   | 150 ns | \$3.45  |
| 6116LP-3    | 2Kx8   | 150 ns | 2.10    |

8087-2 \$185.00  
8087-3 \$135.00  
V20/V30 8 Mhz \$17.50  
80287-8 8 Mhz \$375.00

OPEN 6 1/2 DAYS: WE CAN SHIP VIA FED-EX ON SAT.

NO EXTRA COST  
FOR FED-EX  
SAT DELIVERY  
ON ORDERS  
RECEIVED BY  
Th: Std Air \$6/4 lbs  
Fr: P-One \$13/2 lbs

MasterCard/VISA or UPS CASH COD  
**Factory New, Prime Parts**  $\mu P_{\infty}$   
MICROPROCESSOR UNLIMITED, INC.  
24,000 S. Peoria Ave.,  
BEGGS, OK. 74421 **(918) 267-4961**

Prices shown above are for April 28, 1986

Please call for current prices. Prices subject to change. Please expect higher or lower prices on some parts due to supply & demand and our changing costs. Shipping & insurance extra. Cash discount prices shown. Orders received by 6 PM CST can usually be delivered to you by the next morning, via Federal Express Standard Air @ \$6.00, or Priority One @ \$13.00!



## Puzzles Part II

In Issue 29 we posed the problem: "Two boys were having their purchases totalled at a cash register when the first boy noticed that the checker was hitting the times button rather than the plus. When he commented to the second boy, his friend told him not to worry, the total would come out the same either way.

"They purchased four items. They paid \$7.11. What was the price of each item? Is there only one solution?"

We were inundated with answers. Despite readers' pleas that we accept a less than precise total ("after all, there's sales tax and such" they mumbled) and the fact cash registers don't deal very well with numbers more than two places to the right of the decimal point, there was only one correct answer. In this solution, both the sum and the product of the four numbers totalled exactly \$7.11.

Solutions came in a variety of languages — Assembler, SBASIC and MBASIC, Turbo Pascal, and C — but the method was the same in all — primes.

*(Editor's note: Hey, hold on a blinkin' minute. I didn't use primes. I used brute force: floating points and co-processors thrashing about in gigantic loops, and I got the right answer too! Of course mine wasn't as fast in C on the 32032 as the following 16-line BASIC program was on a Z80... But then I learned some pretty interesting stuff about floating point processors. See the editorial.)*

## A Prime Example

Tom Wilheit from Crofton, MD was among those who submitted the right answer. Here's how he does it:

First, he defines the problem: find four integers whose sum is 711 and whose product is  $711 \times 10^6$ . Then he factors the product and finds that it may be expressed as  $79 \times (2^6) \times (3^2) \times (5^6)$ . The problem becomes arranging these 15 prime factors into four terms which add up to 711.

If the value of any term is N, then the sum of the remaining terms must be equal to or greater than

$3 \times (711 \times (10^6)/N)^{(1/3)}$ . Using this, some simple computations will show that all the terms must be in the range 75-319. One of these terms must contain the largest prime: 79. In order that the term remain in the permitted range it can be multiplied by 1,2,3, or 4. At least one of these remaining three terms must have at least two factors of 5 (i.e. 25). The resulting 25 can be multiplied by any integer from 3 to 12 and stay in the permitted range. Tom eliminates 7 and 11 because they are not in the list of available prime factors.

Thus he is able to specify four possibilities for the first two terms. If two terms are specified then he knows the sum and product of the last two terms; and they can be solved for directly. Thus by direct calculation, he can test these 32 possibilities.

Tom's simple but elegant program in MBASIC runs in about three seconds and shows the correct solution of \$3.16, \$1.50, \$1.25, \$1.20.

## One Good Answer Deserves Another

At press time, we'd received the right solution from the following people:

Tom Wilheit, Crofton, MD  
David Barbour, Berkeley, CA  
Michael Salmon, Australia  
Stephen Roe, Albany, CA  
Donald Sengpiehl, Round Hill, VA  
Don Brittain, Port Jeff. Sta., NY  
Richard Levine, San Diego, CA  
Henry King, Hyattsville, MD  
John M. Smith, Torrance, CA  
Greg Hall, Woodinville, WA

Even the wrong answers were interesting, if only for a good laugh. The following solution from Gene Austin of Pinehurst, ID is worth printing:

"I think the answer is the cube root of 4 + sales tax. My thoughts are as follows:  $X^4 = 4 \times X$  THEN  $X^4 - 4 \times X = 0$  AND  $X \times (X^3 - 4) = 0$  OR  $X^3 = 4$  AND  $X = \text{CUBE ROOT}(4)$  but this then would involve a sales tax of 12%. Pretty high, even for Washington!"

Tom Wilheit's MBASIC Program

```
10 FOR M=1 TO 4
20 FOR N=3 TO 12
30 IF N=7 THEN 150
40 IF N=11 THEN 150
50 F1=79*M
60 F2=25*N
70 PROD=(711/F1)*(400001/N)
80 SUM=711-F1-F2
90 DISC=SUM*SUM-4*PROD
100 IF DISC < 0 THEN 150
110 DISC=SQR(DISC)
120 F3=(SUM+DISC)/2
130 F4=(SUM-DISC)/2
140 PRINT F1,F2,F3,F4
150 NEXT N
160 NEXT M
```

## Same Puzzle, New Twist

Several readers begged us not to put too many puzzles in The Culture Corner, since they felt compelled to solve them. But tax season is over and vacation is about to begin, so what the heck — here's another:

John M. Smith (above) of Torrance, CA asks: What is the smallest total amount the boys could have spent but still have purchased four items whose sum and product were equal?

## SOG Tryout

Since Oregon has no sales tax, you can try out your solution at SOG. You'll be far from home in case something goes wrong:

"That's right, I want you to multiply these four items instead of adding them."

"No, I'm not going to ask you to break a fifty."

"No. No really, you don't have to call the manager."

## Anyway

Send in your answers right away, and we'll print them in Issue #31 (we'll have copies of #31 at SOG). And speaking of SOG, bring your brain teasers so we'll have fresh fodder for future Culture Corners.





## Weird Projections & Artificial Intelligence

*I hate to admit it but after the last "On Your Own," this column is almost mundane. "86 World" grabbed the baton this issue on importing your own systems and I'm really excited about all the AI articles.*

*In fact, you could think of this entire issue as a sort of "On Your Own." If you're looking for something with immediate commercial value, look no further than AI.*

A couple of months ago a quick-printed, computer output, pamphlet called "Computer Industry Abstracts" (CIA!) showed up on my desk.

Paper-clipped to the front was a letter which began "Attention: David J. Thompson, Editor."

Taking that to mean me, I read further. "Abstracts are mailed quarterly for an annual subscription of \$195." One of the sheets was askew (a sloppy foreign agent perhaps?). I looked it over carefully before sliding it back into place.

Obviously this was no cheap publication (despite appearances) so I had to check it out. It was covered with numbers — plain, unadorned, dry, lifeless numbers. And worse yet, the numbers were projections pirated from such radical hacker rags as Computer Systems News, Datamation, Infoworld, Fortune Magazine and Business Week.

### Projections

Let me give you some numbers as reported by CIA.

The sales projections shown in Figure 1 were reportedly made by Computer Merchandising and Computer-World during Oct. 1985.

I don't know if any of these numbers can be real, but they can't all be. So if projections differ that wildly when the year's almost over I

wouldn't put much credence in their stabs at 1986.

However, numbers do tell you what the writer guesses will happen. When the numbers go up, the writer is saying he's excited about that area, and vice versa. (See Figure 2).

### Flies In The Projections

Before you start spending the millions you're going to make selling Ada programs to the Defense Dept., let me point out something.

The computer industry was trucking along on these kinds of projections a year ago when suddenly the market went south (it was a cool spring). Hardware manufacturers discovered that computers in the warehouse don't equal dollars in the pocket and software folks found out that those same lonesome computers don't buy software.

Oh, the market didn't go away exactly, it just stopped growing, and believers in all those super growth numbers found out that their numbers were really just that, numbers.

### AI

Another problem with projections is that the projectors (projectionists?) appear to have the old NMOS crystal balls.

Look at the AI projections. I think they're way, way low. It's obvious to me that AI will be the next spreadsheet, so to speak. LANs, communications talkers, accounting calculators, database finders, graphics scribblers, music generators, even compilers and assemblers will contain bits and pieces from AI.

What if your accounting package understood what was going on in your business? What if it contained the expertise of a CPA?

What if your modem package could log onto Compuserve at 2 a.m., check for messages, leave messages, and then log off? Perhaps it could also get

into a stock database, search for information significant to companies you're currently holding and have a summation ready by breakfast (and it might add suggestions for new purchases).

What if a music package could digitize sounds, analyze the uniqueness of a sound or song, modify it based on its "experience" with other songs or sounds and then play this new creation?

If a song springs full-blown to mind you could just hum a few bars, tell the package which instruments you wanted and presto. Show that to your kids. Do you think they'd go back to driving a turtle around the screen? Do you think composers would still be scratching little round dots on blank staves? (But then people are still writing books on ancient Royals.)

### Programming

But you don't have to come up with a new "spreadsheet" to take advantage of the AI movement. There is already substantial demand from business and industry for people who can take expertise and put it into a computer. AI appears to be the best meal ticket available at this time.

Anyway, use the above numbers as you wish. But if anyone tells you there are no longer any opportunities for individuals in the computer business he'll only be displaying his own (artificial) intelligence.





Figure 1 - Contrasting Sales Figures & Projections (in \$Millions)

|           | Computer Merchandising |       | ComputerWorld |      |
|-----------|------------------------|-------|---------------|------|
|           | 1985                   | 1986  | 1985          | 1986 |
| IBM AT    | 1,690                  | 3,180 | 94            | 342  |
| AT Clones | 490                    | 1,570 | 292           | 568  |

Figure 2 - Retail Sales Projections & Totals For 1984 through 1990 (in \$Millions)

|                               | 1984   | 1985   | 1986   | 1987   | 1990   |
|-------------------------------|--------|--------|--------|--------|--------|
| <b>HARDWARE</b>               |        |        |        |        |        |
| Personal Computers (all)      |        | 2,500  |        |        | 9,000  |
| Desktop publishing hardware   |        |        | 230    |        | 1,000  |
| Process Control Systems       |        | 111    |        |        | 2,090  |
| Local Area Network Hrdware    | 250    |        |        |        | 4,600  |
| Modems                        | 540    | 760    | 1,000  | 1,300  | 2,400  |
| <b>SOFTWARE</b>               |        |        |        |        |        |
| All IBM Software              | 3,200  | 4,300  | 5,800  |        | 19,500 |
| Ada (Defense Dept)            |        |        | 850    |        | 15,000 |
| AI Software (PC)              | 30     | 65     | 130    | 230    |        |
| Self improvement software     |        | 75     | 100    | 133    | 317    |
| PC Accounting Software        |        | 1,400  |        | 2,300  | 3,800  |
| Micro to Mainframe link soft. | 72     | 130    | 233    | 420    |        |
| Data Communications soft.     | 40     |        |        |        | 360    |
| Networking software           | 13     |        |        |        | 500    |
| <b>TOTAL</b>                  |        |        |        |        |        |
| All micros, Hard. + Soft.     | 14,000 | 22,000 | 26,000 | 34,000 | 58,000 |

## XEROX® 820-1 & 2 Assembled & Tested

|              |         |              |         |
|--------------|---------|--------------|---------|
| 820-1        | \$50.00 | 820-2        | \$70.00 |
| CP/M (8")    | 35.00   | CP/M (8")    | 35.00   |
| 820-1 w/CP/M | 70.00   | 820-2 w/CP/M | 90.00   |

Xerox is a trademark of Xerox Corporation. CP/M is a trademark of Digital Research.

### OEM

Sips Inductors  
Sockets Regulators  
Linears Resistors

### HOBBYIST

Pots 7400 Dips  
Caps 74LS Chips  
Some ECL and more...

5 1/4" DSDD  
80 Track 96 TPI  
Philips® Drives  
\$100.00

**Z80-B 6MHz \$4.50**

**3P+N POWER SUPPLY**

Single board power supply kit with  
2 positive fixed voltages. +1 and -1  
variable.

**KIT \$54.95**

Authorized dealer for:



## E<sup>2</sup> COMPUTER PRODUCTS

2273 American Ave. #8 - Hayward, CA 94545  
(415) 786-9203

TERMS: All orders are F.O.B. Hayward California - Prepayment or C.O.D. - California residents add sales tax - Prices subject to change without notice - Quantities limited to stock on hand

## THE NEW 65/9028 VT ANSI VIDEO TERMINAL BOARD!

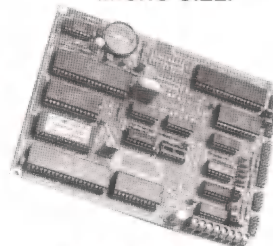
★ FROM LINGER ENTERPRISES ★

A second generation, low cost, high performance, mini sized, single board for making your own RS232 Video Terminal. Use as a computer console or with a MODEM for hook up to any of the telephone-line computer services.

### FEATURES:

- ★ Uses the new SMC 9028 Video Controller Chip coupled with a 6502A CPU.
- ★ RS-232 at 16 Baud Rates from 50 to 19,200
- ★ On board printer port!
- ★ 24 X 80 format (50/60 Hz).
- ★ For 15,750 Hz (Horiz.) monitors.
- ★ 3 Terminal Modes: H-19, ADM3A, and ANSI X 3.64-1979
- ★ Wide and thin-line graphics.
- ★ White characters on black background or reversed.
- ★ Character Attributes: De-Inten, Inverse or Underline.
- ★ Low Power: 5VDC @ .7A, ± 12VDC @ 20mA.
- ★ Mini size: 6.5 X 5 inches.
- ★ Composite or split video.
- ★ 5 X 8 Dot Matrix characters (U/L case).
- ★ Answer back capability.
- ★ Battery backed up status memory.
- ★ For ASCII parallel keyboard.

### MICRO SIZE!



**\$99<sup>95</sup>**  
(Full Kit)

**SOURCE DISKETTE:**  
PC/XT FORMAT  
5 1/4 IN. \$15

**ADD \$40 FOR A&T**

## Digital Research Computers

(OF TEXAS)

P.O. BOX 381450 • DUNCANVILLE TX 75138 • (214) 225-2309

Call or write for a free catalog on Z-80 or 6809 Single Board Computers, SS-50 Boards, and other S-100 products.

TERMS: Add \$3.00 postage. We pay balance. Orders under \$15 add 75¢ handling. No C.O.D. We accept Visa and MasterCard. Texas Res. add 5-1/8% Tax. Foreign orders (except Canada) add 20% P & H. Orders over \$50 add 85¢ for insurance.



Path Searching  
 Archiver  
 8Mb Print Spooler  
 Aliases  
 Disk Variables  
 Screen Paging  
 Multiple Commands  
 Pipes  
 Memory Management

# CP/M<sup>TM</sup> + ConIX<sup>TM</sup> =

I/O Redirection  
 Function Keys  
 Argument Handling  
 Virtual Disk  
 Overlay Searching  
 Memory Files  
 New SysCalls  
 Perfected User Areas

If you've tried some of the earlier CP/M-80 add-ons such as Microshell<sup>TM</sup> and ZCPR<sup>TM</sup>, then you know it's possible to add new features to CP/M. Now you can have much more without all the trade-offs when you use ConIX - **the latest and greatest upgrade for CP/M!**

"(ConIX) goes a great deal farther in flexibility than any other CP/M shells. . . this system has all of its competitors beat." *Computer Language*, 6/85.

## ConIX Operating System: List \$99.95 **Special**

A complete upgrade for 48K+ CP/M 2.2/3.0 and equivalent systems. Provides professional capabilities with blinding speed, as often found on more expensive MS-DOS<sup>TM</sup> and UNIX<sup>TM</sup> machines. Installs easily in 1 minute to add over 100 new commands and features. Eliminates all points of user frustration with CP/M. Uses only 1/2K TPA, 0-27K disk minimum.

ConIX is the greatest, most powerful 8-bit upgrade, with speed and capabilities that are so incredible it's bringing users *back* to CP/M!

## ConIX Pull-Down Menu: List \$34.95 **Special**

A user-friendly interface to ConIX that is fully menu-driven, with helpful prompts and easily understood explanations of all menu functions. Loads with a single keystroke at the prompt level. Source code included!

## ConIX Programming System: List \$99.95 **SALE**

A full programming language for ConIX extends CP/M SUBMIT capability. Features conditionals, loops, subroutines, labels, nesting, interrupt processing, error traps, and debugging facilities. Design intricate menu systems. Includes a special "compiler" that provides string and numeric variables, an integer math package, a relocatable assembly code generator, and much more. A *must* for CP/M power-users and developers!

## ConIX Library I - XCC Utilities: List \$49.95 **SALE**

Over 25 utilities written in the ConIX shell language, including hierarchical directories with overlay - adds pathname capability to existing software, interactive debugger, move/copy/link multiple files, print files with pagination, review disk files for deletion, unerase disk with stats, full-screen TYPE, and more. Source code included! Does not require Programming System.

## NEW YEAR SPECIALS - SAVE 30% TO 100% OFF!

- ConIX O.S. or Programming System: **\$49.95 each**
- ConIX O.S. and Programming System: **\$79.95 for both**
- SUPER SAVINGS WHEN YOU BUY 'EM ALL: ConIX O.S., Programming System, Menu System, Library I - **Only \$99.95!!**
- ConIX Menu System: **FREE with ConIX!**
- ConIX Library I: **\$34.95 with any ConIX product**

Now that we've knocked the bottom out of our prices, you should have no reason to suffer along with plain-old CP/M or incompatible half-baked add-ons any more! Get started with ConIX for \$49.95, or steal us blind and get everything for only \$99.95. Either way, you get the Menu System absolutely FREE! Get on the bandwagon with a company that's committed to *you* with the ongoing development of products for CP/M and ConIX.

Prices include manual, 8" disk, and end-user support. 5¼" disk conversions: 48TPI \$6, other \$10. Shipping: \$4.50 UPS, \$10 Canada, \$15 overseas. NY residents add sales tax. Discount incentives for Dealers, OEMs, User Groups - CALL!



**Computer Helper Industries Inc.** • P.O. Box 680 • Parkchester Station, NY 10462  
 800-628-2828 X513 24hr. order hotline - COD only • 212-652-1786 M-F:10-6 sales/technical staff

"We're helping your computer work better for you!"

Trademarks - CP/M: Digital Research, ConIX: Computer Helper Ind., Microshell: New Generation Systems, ZCPR: Richard Conn/Echelon, MS-DOS: Microsoft, UNIX: AT&T Bell Labs



# NOW AT THE SBC MART COMPUTING SALE-A-THON

## THE BEST OF BOTH WORLDS

Run your CP/M programs on any IBM PC or compatible. RUN/CPM transforms your PC's floppy drives into CP/M drives able to directly read, write and format over 100 CP/M disks. RUN/CPM directly executes your CP/M programs. Kaypro, Morrow, Osborne, Cromemco, Heath, many more. Because this is a hardware solution, your programs run up to 30% faster.

★ RUN/CPM only \$79 (Requires NEC V20 chip below)

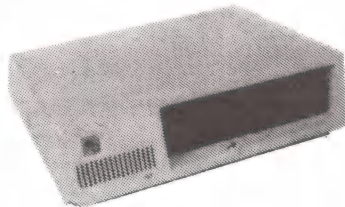
## PC SPEEDUP KITS

★ NEC's V20 chip will increase the throughput of your system up to 90%. That's almost double your present processing speed. 5MHz kit \$24. 8MHz \$29.

## ADD-ON CARDS

- multifunction card 384K, clk/cal w/battery, serial, parallel, and game ports, with OK save \$50 **Model MFC-4 \$135**
- monochrome graphics card runs 1-2-3 graphics, w/printer port, 720x348, **MGC-1 now \$135** (Hercules equiv.)
- floppy controller for 1-4 48tpi or 96tpi drives, w/cable save \$25 **Model FDC-2 now only \$74**
- color adapter w/light pen port, RGB and composite outputs reg \$140 **Model CC-1 now just \$116**
- ★ **better than the Super 7:** floppy disk controller, clk/calendar, serial, parallel & game ports, spooler & RAMDISK s/w **Sale \$145** ideal mate for 640K motherboards
- clock/calendar card reg \$58, **CL-1 \$149**
- ★ **OMTI hard disk controller card** (this card is super fast) reg \$220, **Model HDC-1 now \$175**, w/cables

## CASES



- high quality IBM PC look alike w/side-switch, flip-top or side chassis
- any-combo disk drive brackets
- heavy steel, 8-cutout style
- **Model CA-8** reg \$95, **now \$69**

## SBC PLEDGE

- ★ service after sale    ★ technical support
- ★ low prices            ★ one year warranty

## MOTHERBOARDS



- full IBM PC/XT compatibility
- 8 I/O slots
- runs IBM's PC-DOS 3.1
- BASIC interpreter available
- great foundation for business or personal system
- 1 year warranty

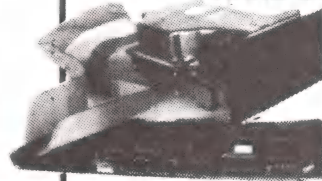
- ★ **Model MB-1** 256K motherboard with OK regularly \$295, **now \$199**
- ★ **Model MB-3** 640K motherboard with OK regularly \$399, **now \$250**
- ★ **Model MB-2** 640K motherboard, 4.77 and 7+ MHz clock, w/256K Reg \$399, **now \$297**, this is a fast board.

## ABOUT OUR MOTHERBOARDS

- the most IBM PC compatible motherboards available
- each runs *all* commercially available software
- each works with all commercially available add-on cards

These FOUNDATION motherboards are the most compatible you can buy. All work with V20 chips, have parity checked memory, an 8087 socket, 8 adapter slots, four empty ROM sockets. Super manual includes complete data on how to put together a complete PC system. It even includes schematics.

## HARD DISKS



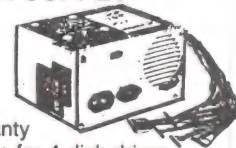
- complete 10MB Kit
- **special, only \$398**

- complete internal 1/2-high 10MB kit, incl. controller and cables, **special \$398**.
- complete 10MB kit with low power 3-1/2" half-high drive, fits 5-1/4" slots, **\$469**.
- 3-1/2" 10MB Winchester drive alone **HD-3 just \$380**.
- 20MB half-high drive **HD-2 now \$395**.

## HARDWARE SPECIALS

- keyboard 5150 style regularly \$125, **Model KB-3 only \$85**
- keyboard 5151 style regularly \$175, **Model KB-3 only \$99**
- memory nine 150ns DRAMs **Set ID-256** 256K reg \$55, **now \$34**
- no better **DS/DD** drives anywhere, 48tpi **F-4 \$99**; F-9 96tpi **\$129**
- ★ Smarteam modem (fully Hayes equivalent) 300/1200 baud auto ans/dial, reg \$399, **now just \$249**

## POWER SUPPLY



- 135 Watts
- side switch
- top quality
- one year warranty
- standard cables for 4 disk drives
- **Model PS-135** power supply regularly \$129, **now only \$85**

## LAST MINUTE SPECIALS

- ★ **RUN/CPM only \$79**--see details in upper left corner of this ad
- IBM PC-DOS 3.1 \$85 (only \$65 with motherboard); Ellis PASCAL, COBOL, FORTRAN, BASIC compilers only \$34 ea; MS mouse w/PC Paintbrush \$145
- ★ **COMPLETE 100% IBM PC equiv syst \$987**
- ★ **96tpi drive package: over 800K on a single floppy, complete kit with 96tpi drive, software \$149**

Shipping and handling: drives/motherboards/cases/power supplies \$4.50 ea, cards \$2 ea, software \$2.50 ea, keyboards/modems \$4 ea, speedup kits \$2 ea, memory \$1/set, COMPUTERFACTS \$3 first set then \$1/set. CA residents add 6% sales tax.

**To order or for further information: CALL (619) 375-5744**

**The SBC MART, P.O. Box 1296, Ridgecrest, CA 93555**



AMERICAN  
EXPRESS

The SBC Mart is part of Computing Technology, 821-B Commercial Street, Ridgecrest, CA 93555



By Stephen M. Leon

200 Winston Drive  
Cliffside Park NJ 07010

## PC Games & A Z80 Emulator

*Steve receives a commercial, copy protected word processor, and guess what? The same program is available in the public domain. But, the big news this time is the Z80 emulator that runs on the 8088. You can run Z80 Turbo on a PC — slowly, but surely.*

A computer magazine arrived at my house recently with a relatively new innovation in software distribution — a program disk sealed in light cardboard bound into the magazine. The gimmick was that the copy protection scheme allowed you to run the program a limited number of times. For something like \$70 they would give you the unlocking key.

It was a word processor, but having just updated to NewWord3 (a phenomenal improvement over both WordStar and the old NewWord), and being inherently cheap, I was more interested in the free floppy than the program. However, we ran it just to see what it was like — and it seemed to have a familiar face!

It appears that this same word processing program without copy protection is in the PC/Blue library as shareware. The same holds true with many other programs both in the DOS and CP/M worlds. There are lots of things for free that are equal to, better than, and in some cases identical to, commercial products.

### Z80 Emulation On The PC

I still use my TRS-80 Model 1 to check some of the Z80 contributions to SIG/M. However, thanks to Joan Riff of Computerwise Consulting Services, I may be able to finally send the Model 1 to its long earned rest. Joan has written and donated to the public domain Z80MU (PC/Blue 185). The title of her documentation says it all: "Z80 and CP/M 2.2 Emulator User's

Guide for The Care and Feeding of Your Imaginary Z80, or Fakeware For the Techie Masses!"

There I was — no V20 chip, but running Turbo Pascal Z80 CP/M programs on the PC. Sure they could have run faster (Joan is working on that). Sure some of the screen display needed reworking, etc. However, this disk is a significant contribution to the public domain (this is not a "send me money program"). It comes with source code, a good manual, and it works! What more can you ask?

### Drivers, SYSLIB, Etc.

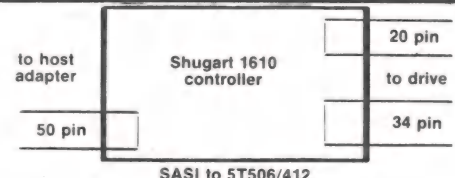
I suspect that Micro C probably has a higher percentage of the CP/M-86 and Concurrent CP/M users than any other magazine. For those of you in that category, we have four new "must" volumes in the SIG/M library.

DRI recently sent over their GSX drivers, and we released them as volumes 257 to 260. There are too

many useful modules on these disks to go into detail. Suffice it to say, for anyone doing assembly language programming in CP/M-86 or Concurrent, you must get these disks.

For CP/M-80 assembly language programmers, Rich Conn has done it again. We now have "grandson of SYSLIB." The updated SYSLIB 3.6 Library of Routines is available on SIG/M volumes 261 to 264. Take this as a hint that an update to ZCPR is due out shortly.

Another recent addition to the SIG/M library is an implementation of the IEEE 855 (MOSI) interface by Professor James D. Mooney of the Department of Statistics & Computer Science at West Virginia University. MOSI stands for Microprocessor Operating System Interface and is independent of the programming language. The programs on SIG/M Volume 253 contain an interface for CP/M 2.2 and for Pascal MT+ together with comprehensive



## 5 1/4" HARD DISK CONTROLLERS

These new factory sealed Shugart controllers have manuals and schematics available. They will control up to two 5 1/4" hard disk drives with up to 16 heads each. These unique controllers will mount directly on the drive. By the change of an EPROM they change their instruction set to emulate other popular controllers.

- \*Shugart 1610-3 emulates **Xebec** S1410
- 1610-1 emulates **DTC** 510
- 1610-4 SCSI version

Using standard host adapters they work with:

- \* **Apple** II, II+, IIE
- \* **MAC** (see Sept. Dr. Dobbs)
- \* **TRS 80** model III, IV
- \* **ISI 5160 & ACS 1000** (PC clones)
- \* **Wavemate** Bullet
- \* All **AMPRO** boards (little board, etc.)
- \* And other systems with SASI Ports or host adapters

1 for \$99. ea. 2 for \$90. ea. 100 for \$75. ea. Manual and schematic available.

• **Computer Surplus Store (408) 280-1746 •**

Other controllers also available for 5 1/4", 8" and 14" drives including Shugart SA1000, 4000 SERIES and Quantum 2000 SERIES (DTC 510B, 1404, 1404D, 1403, 1403D, 1408I, 1420-1, OMTI 20C, 20L).



documentation designed to whet the appetite of the user into additional implementations for other languages and systems.

Our friend from Mexico, Professor Harold McIntosh, has come up with an update to his multi-column printing disk. SIG/M Volume 254 lets you print up to four columns and four files on one or two sides of a page. As is usual with the good professor, code is provided in both CP/M-80 and 86.

We haven't seen a great rush to CP/M 68K. SIG/M Volume 256 contains two utilities (file compare and query erase), but we're always looking for more. On the same disk is a program to transfer files between MS-DOS and CP/M in Turbo Pascal. A program of interest to Kaypro owners is a dynamic trace disassembler on Volume 252. However, it works only on older models with the non-graphic screen.

#### News From PC/Blue

New and worth mentioning from PC/Blue is DISKIT, a disk repair utility on Volume 176. On 178 we have the PC MAGAZINE benchmark test series. Volume 181 has PC-Kat, a diskette cataloguer. On 182 we have Cut/Paste and Notepad, memory resident utilities like Sidekick. A new version of PROLOG is on PC/Blue 183.

There certainly is no shortage of word processing programs in the PC/Blue library. Working our way backwards through the catalog, on 185 is NYWord. On 182 we have Freeword. A scientific notation word processor (ChiWriter) is on 173. PC-Write version 2.55 (a much acclaimed word processor) is on 167 (version 2.4 is on 130). Volume 95 contains a word processing program for children. The MS-DOS version of ROFF is on 86. There are a few more, but I think the message is clear. If you need a word processor for your PC, you certainly should be able to find it in the library.

#### Games

Got a note the other day from someone complaining that we rarely mention games. The PC/Blue library does have games. However, I have to ask — when is a game not a game, but rather an insult? Take for example Naval War Simulator on PC/Blue 178. I know Hank Kee is one of those people you can find on the job at almost any hour day or night. On this one, I think he may have been sound asleep when he let it by.

I won't give a nickel to "ask for money" software unless the program is something I find of such value that I would go out and buy it as a commer-

cial product (for example, Tommy Rettig's dGENERATE). Naval War Simulator is a sample game — hence a simulated game — that has the audacity to ask for a \$5 donation if you like the sample. Then it pitches you to buy the "enhanced version." This kind of garbage belongs in a waste basket, not in a library or on a bulletin board.

As a saving grace, Henry also included on 178 CaveQuest, a dungeons and dragons game. CaveQuest is well worth getting. What I suggest you do is get volume 178 and send a nasty note to Shadow Mountain Software after you erase NWS.

Other games in the PC/Blue library include: Twenty miscellaneous games on 153 and thirty more on 147. If you want more, Spacewar is on 128, and four other game programs are on 102. A three volume multi-user SuperTrek is on 90-92. Twenty-one other games (including Chess, Eliza, Othello, PCPONG, etc.) are on Volume 25. Volume 24 has another 19 games, including Blackjack, Cribbage, Slot Machine, etc. Most games require a color monitor. SuperTrek requires an 8087.

#### Computer Hobbyist Of The Year

The Computer Hobbyist of the Year Award is presented at the Trenton Computer Festival to the individual who has made an outstanding contribution to amateur personal computing. It is, in effect, the "Oscar" of amateur personal computing.

The nominees for the 1986 award were William Bolton of New South Wales, Australia, Jud Newell of Toronto, Canada, Irvin M. Hoff of Los Altos Hills, California, and Sol Libes of Mountainside, New Jersey.

Bolton was cited for his efforts to bring amateur computing to Australia and New Zealand through his pioneering efforts in setting up bulletin board systems, acting as a distributor of public domain software, and contributing a vast number of original programs and translations to the public domain.

Newell was nominated for his contributions to the development of amateur computing and bulletin board operations in Canada as well as for his efforts in implementing the Canadian

## Ever Wondered What Makes CP/M<sup>®</sup> Tick?

Source Code Generators  
by C. C. Software can  
give you the answer.

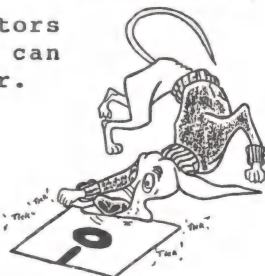
"The darndest thing  
I ever did see..."  
"... if you're at  
all interested in  
what's going on in  
your system, it's  
worth it."

Jerry Pournelle,  
BYTE, Sept '83

areas). To modify the system to your liking,  
just edit and assemble with ASM. CP/M 2.2 \$45,  
CP/M+ \$75, + \$1.50 postage (in Calif add 6.5%).

C. C. Software, 1907 Alvarado Ave.  
Walnut Creek, CA 94596 (415)939-8153

CP/M is a registered trademark of Digital Research, Inc.



The S.C.G. programs produce  
fully commented and labeled  
source code for your CP/M  
system (the CCP and BDOS.

(continued next page)



(continued from page 83)

distribution of public domain software.

Hoff was cited for his work upgrading Christenson's MODEM into the MDM series and IMP. He was further cited for his assistance to newcomers to computing via Compuserve.

Libes was nominated for service over an 11-year period in promoting personal computing as a founding member of the Amateur Computer Group of New Jersey, editor of Microsystems and Microsystems/Journal, and author of numerous books on computing and electronics.

The 1986 winner was Sol Libes.

### Joining The Public Domain Parade

There is no shortage of contributors to both the SIG/M and the PC/Blue libraries. I must have about 30 volumes of material that I have yet to review for new releases for SIG/M, and new material comes in every week. (Henry Kee, PC/Blue disk editor, probably has a bigger backlog. He

even gets nasty calls on why the material isn't yet out. However, most of his releases ask for donations, hence the impatience.)

Making a donation to your colleagues in computing is not that hard. All you do is fill in the donation form (found on most library disks) and send the disk to either SIG/M or PC/Blue. The SIG/M donation form differs slightly from the PC/Blue form in that we ask you to state that the program does not contain a request for money. PC/Blue allows shareware.

SIG/M disks also usually contain source code. Not so with PC/Blue, although as mentioned before, Joan Riff's Z80 emulator not only contains source code, but it also is a true public domain program. There are many other such contributions in the PC/Blue library, and yours truly would personally prefer to see less shareware and more true contributions there.

If you make a donation to SIG/M and we publish it, we give you your choice of two free library disks. You may want to check this out with your


accountant, but if you developed software for commercial purposes and have a cost basis on it, you might be able to get a tax deduction out of the contribution. (I would suspect, however, that if your commercial sales have reached the point where you are giving it away, you are in a loss position.)

So why not share that software with the rest of us, and support public domain software with a contribution.

### 5" Disk Formats On SIG/M

While SIG/M has traditionally distributed programs only on 8" SSD disks, we have for some time recognized the need for 5" distribution. Thanks to a Maynard disk controller and Uniform on a PC, we are experimenting with distributing 5" disks. (We still prefer that you get your volumes locally or via BBS systems). The charge for 5" disks is \$7 per volume. However, for SSD formats, or any format which requires more than one disk, please add another \$2 per volume.

**"IF YOU'RE LEARNING C AND NOT USING ECO-C88, YOU'RE WORKING TOO HARD!"**



Eco-C88 is a full C compiler for MSDOS machines. Everything you need is included in the low price of \$59.95, including a full-screen editor. Here's what some reviewers are saying about the Eco-C88 C Compiler:

"Eco-C performed well on all the benchmarks, generating code that was quite comparable to that of compilers 10 times as costly."  
*Christopher Skelly, Computer Language, Feb., 1986*

"This compiler does handle syntax errors much better than average - no avalanche of spurious messages here."  
*William Hunt, PC Tech Journal, Jan., 1986*

"Eco-C88 is a high-quality package... convenient to use..."  
*Dr. David Clark, Byte, Jan., 1986*

"Eco-C is definitely a bargain... it includes both the compiler and an excellent Turbo-style editor... a useful compiler for advanced applications, and will serve far beyond the beginning phase."  
*Gary Entsminger, Micro Cornucopia, April-May, 1986*

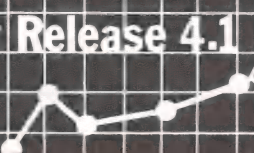
The compiler comes with a standard library of over 200 functions, cc and "mini-make" utilities, ANSI language enhancements (e.g., prototyping), expanded user's manual, plus much more, all for the low price of only \$59.95. Also ask about our support products!

If ordered with the compiler, the C library source code (excluding transcendental) is \$10.00 and the ISAM file handler (as published in the **C Programmer's Library**, Que Corp) in OBJ format is an additional \$15.00. Please add \$4.00 for shipping and handling. To order, call or write:

**Ecosoft Inc.**  
6413 N. College Avenue  
Indianapolis, IN 46220  
(317) 255-6476 • 8:30-4:30

1-800-952-0472  
(orders only)


**New Release 4.1** *Microstat*






We've continually improved Microstat since it was introduced in 1978, and the latest release includes many new features you've wanted.

|   |  |
|---|--|
| <ul style="list-style-type: none"> <li>Interactive and Batch Processing</li> <li>Expanded Data Management Subsystem with New Data Transforms</li> <li>Reading data files created by other programs (e.g., Lotus)</li> <li>3 types of Analysis of Variance</li> <li>Time Series</li> <li>Crosstabs and Chi-Square</li> <li>Factorials, Permutations, and Combinations</li> <li>Hypothesis Tests</li> </ul> | <ul style="list-style-type: none"> <li>Data sets that can exceed memory</li> <li>Multiple Regression (including Stepwise)</li> <li>Scatterplots (including best fit regression)</li> <li>Correlation Analysis</li> <li>12 Nonparametric tests</li> <li>8 Probability Distributions</li> <li>Descriptive Statistics</li> <li>Easy Installation</li> </ul> |
|---|--|

Microstat's algorithms have been designed to prevent numeric overflow errors and yield unsurpassed accuracy. Microstat's price is \$375.00 including the user's manual and is available for the Z80, 8086, 8088 CPU's and CP/M80, CP/M86, MS-DOS, and PC-DOS. To order, call or write.



Trademarks: Eco-C88, Microstat (Ecosoft), CP/M (Digital Research), MSDOS (Microsoft), PC-DOS (IBM), Z80 (Zilog), 8086, 8087, 8088 (Intel).



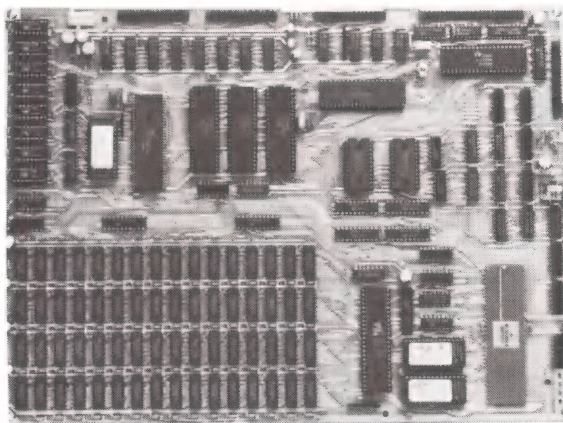
#### How To Order

SIG/M volumes are available on 8" SSD disks for \$6 each (\$9 foreign) directly from SIG/M, Box 97, Iselin, NJ 08830. Printed catalogs are \$3 each (\$4 foreign). Disks in a variety of formats may be obtained through the worldwide SIG/M distribution network. For those of you unable to get the standard 5" formats through the distribution network, you can now order most of these formats through SIG/M. The price is \$7 per volume (\$9 foreign). If the format requires that the volume be

on two disks (SSSD formats with less than 240K), please add \$2 extra per volume. The distributor list is included with the printed catalog. A disk version of the catalog (Volume 00) is available for \$6. PC/Blue volumes are \$7 each (\$10 foreign). The printed catalog is \$5. Both are available from the New York Amateur Computer Club, Box 100, Church Street Station, New York, NY 10008.



## MULTI-USER 68000 SINGLE BOARD COMPUTER



### FEATURING:

- 8 MHZ 68000 CPU
- 2 Mega Bytes RAM
- Memory Mapping / Manager
- HD 64180 Co-Processor
- 8 Serial Ports
- Floppy Controller
- SCSI / SASI Interface
- Parallel Printer Port

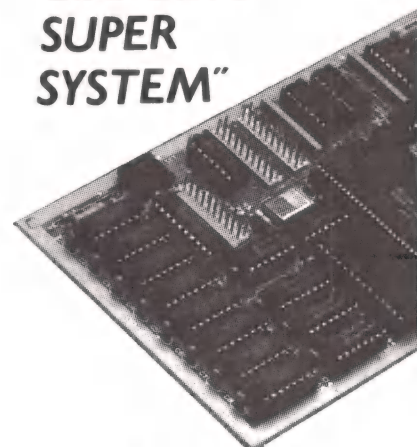
Price: \$1500.00

## HAWTHORNE TECHNOLOGY

8836 S.E. Stark, Portland, Oregon 97216  
(503) 254-2005

Byte Magazine called it.

## "CIARCIA'S SUPER SYSTEM"



### The SBI80 Computer/Controller

Featured on the cover of Byte, Sept. 1985, the SBI80 lets CP/M users upgrade to a fast, 4" x 7 1/2" single board system.

- 6MHz 64180 CPU  
(Z80 instruction superset), 256K RAM, 8K Monitor ROM with device test, disk format, read/write.
- Mini/Micro Floppy Controller  
(1-4 drives, Single/Double Density, 1-2 sided, 40/77/80 track 3 1/2", 5 1/4" and 8" drives).
- Measures 4" x 7 1/2", with mounting holes
- One Centronics Printer Port
- Two RS232C Serial Ports  
(75-19,200 baud with console port auto-baud rate select).
- Power Supply Requirements  
+5V +/-5% @500 mA  
+12V +/- 20% @40mA
- ZCPR3 (CP/M 2.2/3 compatible)
- Multiple disk formats supported
- Menu-based system customization

#### SB180-1

SB180 computer board w/256K bytes RAM and ROM monitor  
..... \$369.00

#### SB180-1-20

same as above w/ZCPR3, ZRDOS and BIOS source..... \$499.00

-Quantity discounts available-

**NEW**

#### COMM180-M-S

optional peripheral board adds 1200 bps modem and SCSI hard disk interface.

TO ORDER  
CALL TOLL FREE  
1-800-635-3355

TELEX  
643331

For technical assistance or to request a data sheet, call:  
1-203-871-6170



Micromint, Inc.  
25 Terrace Drive  
Vernon, CT 06066



## ICM's S-100 Boards

*Dave reviews ICM's single board Z80 processors and slaves. It's obvious that in the S-100 world, the Z80 is still alive and processing.*

This column is the second in a series of mini-reviews of TurboDos-capable S-100 hardware. Along with the usual S-100 tips, circuits, and reader feedback, future columns will include a brief look at the offerings of each manufacturer of S-100-based TurboDos products.

### Intercontinental Micro Systems

Intercontinental Micro Systems' product list is like a supermarket for S-100 shoppers. Besides offering their own S-100 product line, they also have bought the rights to MUSYS Corporation's S-100 bus boards. In fact, ICM has more S-100 products than I can mention in a single mini-review, so their name will probably crop up in future columns. For now, I'll just cover most of the single-board computer products.

### 8-Bit SBCs

I'll start with the 8-bit boards. The first product is the CPZ-4800x series of Single-Board Computers (SBCs). Based on the Z80A processor, these boards offer a Memory Management Unit (MMU), 4-channel DMA, Vectored Prioritized Interrupts (VPI), an SIO (or DART), a PIO, a 2793 FDC, 64K DRAM, and a built-in monitor in EPROM all in the same package. Low-level I/O (like RS-232 drivers and receivers, and floppy I/O configuration) is done via small "personality boards" that contain additional ICs and connectors. Using optional personality boards, the CPZ-4800x can support 5.25" or 8" drives, RS-232, SASI, Centronics, and many other peripheral devices. If you don't want to use them as masters in a TurboDos system, these boards also make dandy stand-alone CP/M systems.

After using two CPZ-48000 boards for the last four years, my only complaint is that a shorted regulator on an RS-232 personality module can cause SERIOUS damage to the main CPZ-48000 board, including destroyed traces and component failure (I've lost two boards this way). An added fuse has saved me from any additional failures. However, this problem exists in all S-100 boards that use personality modules (sometimes called "Paddle Boards"), and is not restricted to just ICM.

### Slaves

ICM's 8-bit slave processors, the CPS-MX 64K and CPS-BMX 128K, are just as impressive as their SBCs. Running at 4 or 8MHz, the ICM slaves have most of the features of the SBCs, including on-board MMU and full DMA capability. Running as a memory-mapped slave under TurboDos, the CPS series slave processors are much faster than most of the I/O-mapped slave boards I've seen.

Like the SBCs, each CPS board has two serial ports, two parallel ports, and two CTCs. Most of the TurboDos gurus I've talked to have said that they find memory-mapped slaves faster than regular I/O-mapped slaves, but a great deal more difficult to implement. If you're running ICM's version or TurboDos, then this shouldn't be much of a problem, since they do it for you.

Hmmm... Out of space already. We'll have to continue this mini-review next time (starting with the ICM 16-bit stuff).

### First Letter

I've received several interesting letters since last time. Much to the relief of my editors, I'm sure, I can't possibly answer all of them here. However, I do have room for a couple of them, so here goes:

Letter number one is from Matt Swarm of The S-100 Board Bank in

Olympia, WA. Matt is currently running a plain vanilla CP/M system, but is planning to upgrade to TurboDos as soon as he can get the hardware put together and debugged. Within his description of the hardware he is assembling, he mentions that he has picked up two Mitsubishi 8" half-height floppy drives and has heard that they're reliable, but is being driven crazy by the clatter they make each time the heads are loaded.

Matt also mentions that some of the S-100 cards he's using (particularly the single-board computers) are "real blast furnaces," and that he's thinking about bypassing the heat-generating regulator ICs on-board and supplying the boards directly with regulated power. He wants to know if anyone else has ever tried running S-100 cards with off-board power regulation.

I can offer some advice about the Mitsubishi floppies because I've been using them myself for the past couple of years on my RCPM system. I can vouch for their reliability, since two of them have been running non-stop without any failures or alignments since the spring of 1983.

As for the noise, there's a simple solution to that. The most annoying part is the loud snap made by the door locks every time the drive is accessed or the head is loaded. Because the door lock is a useless feature in most cases, you can simply defeat it by unplugging it or cutting the door lock relay wires.

If your equipment de-selects the drive automatically when it isn't being used (and thus turns off the DC spindle motor of the Mitsubishi), you can cut down the noise even more by defeating the head-load relay and leaving the heads loaded all the time. Because of the design of the drive, the heads are automatically separated when the disk door is open, even if the head-load relay is energized, so no damage can result from this.

I've modified all four of my Mitsubi-

By Dave Hardy

736 Notre Dame  
Grosse Pointe MI 48203



shi half-heights this way, and they're so quiet I can't even tell when they're being accessed. (These tricks can often be applied to other drives too, but you should be very careful about forcing a "head loaded" condition, particularly if the drive's spindle motor runs continuously, or if the heads must be unloaded prior to removing or inserting a diskette.)

About bypassing the on-board voltage regulators on S-100 cards to prevent excessive heat: Be Careful! If you do it right, you should have no problems, but you should beware of several things before you do it. One of the reasons for the on-board regulators in the first place is to prevent garbage signals from passing between boards via the power supply. Running two S-100 SBCs from the same power supply this way, for example, will probably not work. So be sure that the power lines going to the un-regulated board are adequately filtered (not just for "smooth" power, but also to trap out high frequency noise, switching transients, and the like).

Many of the single-board S-100 computers require extremely clean input power, and, after bypassing the regulators, will run reliably only with additional filter capacitors installed on the board itself. In addition, if forced-air cooling was required before the regulators were removed, it will probably still be required afterward.

Also, if you decide to remove the on-board regulators, be careful to do it in a way that prevents the board from being inadvertently connected to an unregulated S-100 supply, or else the board will change from a blast furnace to a pile of carbonized shredded wheat.

## Second Letter

Letter number two is from Jeff J. Henkels (via GEMail). Jeff is designing a 68000-based CPU card to replace the Z80 card he's currently using in his S-100 system and would like additional information on how to control the interface between the 16-bit 68000 and the 8-bit memory, disc controller, and I/O cards.

"To date," Jeff writes, "I have not seen this material covered in detail in any of the S-100/IEEE-696 literature. I am sure that there are many S-100

hackers who would be very interested in seeing such an article."

Interestingly, I have a column (actually two) planned for just what you have mentioned — using 16-bit devices on the S-100 bus, with and without other 16-bit cards.

Although the IEEE-696 standard allows for 16-bit stuff on the S-100 bus without any "tricks" like multiplexing data/address lines, etc., there are several different schemes for "sneaking" 16-bit processors into an S-100 bus that has only 8-bit cards. Many manufacturers make 68K-based boards that use existing 8-bit cards, including Viasyn (a.k.a. Godbout; CompuPro) and Peak. Viasyn's scheme does some neat hardware tricks to allow the 68K's memory-mapped I/O to be translated to I/O mapping for S-100 peripherals, for example. And, of course, there are

a few timing tricks needed to shoe-horn the 68K into the S-100 bus, too. Peak's design lets the 68K reside in a system with another host processor that it uses for I/O, which makes installation painless.

## Next Time

The next mini-review will cover the popular Earth Computers Z80 slave processor board. If you would like to see a mini-review of a certain S-100 product, please let me know, and I'll be happy to give it the once-over.

Of course, future columns will also include more letters from readers, S-100 tips, and hints. As always, I encourage reader feedback, and welcome questions, suggestions, comments, and ideas for future S-100 Bus columns.



## BEST DEAL EVER ON 45 CPS DAISY WHEEL

**Qume Sprint 3 with Serial Interface** with Logic Seeking Bi-directional Proportional Printing at 300 or 1200 Baud - DTR or Xon Xoff. Has full keyboard so can Double as typewriter.

Guaranteed 90 days .....\$375.

Working but not thoroughly tested .....\$329.

Spare parts available

### SOFTWARE LIQUIDATION

**Accounting Plus (One of the Best) — Buy General Ledger .....\$49.95**  
(Originally \$495 — \$595 per module)  
**Big 3)** and we'll toss in A/R and A/P for only \$29.95 each or pick your modules for \$39.95 each — features password protection, audit trail, double entry, open item, error checking, etc.  
**Buy the whole set G/L, A/R, A/P, Inventory, Payroll, Point of Sale, Sales Order, Purchase Order**  
**Big 8** for ..... \$199.

These disks are in 96 TPI format but we can download to almost any format CPM 86, IBM, or CPM 80 for 1.95 per disk. We have about 80 sets of the Big 8 package and 60 of the Big 3 CPM 86 for IBM and Compatibles ..... \$29.



### HARDWARE LIQUIDATION

**Shugart 410 51/4 SS DD**  
(2 drives in case)..... \$89.  
With Xerox 820 connector ..... \$99.  
Tec 51/4 SS DD for many different computers ..... \$39.  
**Diablo 630 ECS ..... \$895.**  
Diablo 630 API ..... \$795.  
Diablo 630 PPI ..... \$695.  
Diablo 1640-50 ..... \$495-595  
**Xerox 820-1 Single Board Computer**  
complete, tested and guaranteed ..... \$79.95  
Enclosure for above or other SBC..... \$229.95  
(Motorola Monitor, Power Supply connectors etc.)  
Either Tec or Shugart drives above + SBC & Enclosure will make a full system but you need a Keyboard (sold only with system)  
Keytronics full keyboard..... \$51.  
**Complete System 820-1 with, 2 disk drives and keytronics..... \$399.95**  
Power Supplies 200 watts ..... \$39.95  
CPM with Xerox 820 Bios and full Manual..... \$39.95

Shipping and Handling  
charged on all orders

# CRAIG'S

# COMPUTERS

(213) 371-4428 (Days)

(213) 379-1342 (Nights and Sundays)



# LETTERS

(continued from page 4)

## PC Hard Disk

My computer is an Epson QX-10 with a Titan PC-II board which makes it run almost like a PC. I'd love to add a hard disk to my system. I can buy one, but it costs \$1200 with the interface and control boards. I see hard disks advertised for the PC for under \$500 including the controller.

However, on my system (like the Kaypro) I still need an interface to the controller. I know it isn't worth your time to publish an article just for the Epson QX-10, but an article which would show how a Kaypro and any other system could use a PC hard disk might appeal to many of your readers.

**John A. Clinkenbeard**  
5810 Woodbridge Lane  
Midland MI 48640

## Editor's note:

Excellent suggestion, John. However, check the PC-BIOS article in this issue. It would appear from that article that it would be much easier to do a SCSI interface, and add the winnie support to CP/M's BIOS (or as a driver in MS-DOS).

*Anyone have any other suggestions?*

## Amiga Aficionado

I just read Issue 28 and feel I should speak out in defense of the Amiga. I bought mine in November (for some reason, we Canucks seem to have been blessed with availability well before our southern friends), and use it daily for writing letters, communicating with BBS'es, keeping track of marks, and programming in C.

There's no question that the graphics are mind-blowing (the Electronics Arts demo disk that comes with the machine is a good substitute for cheap drugs), but I like the AmigaDOS environment for business and programming applications as well. It's great to have a full-screen editor, text file sort utility, and file joiner all built into the DOS (not to mention the built-in RAMdisk!). It's also great to be downloading a file, printing a report, and editing a program — all at the same time.

Speaking of DOS, I haven't seen the rumored crashes, except when I run out of memory, and you sort of get a

feel for when that's going to happen. Anyway, all you need to do is re-boot (you don't need to reload Kickstart). The DOS that originally came with the machine (Version 1.0) had a few bugs (notably the serial drivers), but DOS 1.1 seems to have solved that.

## My only complaints are:

1. No software. I have Delux Paint and Lattice C, but there's no business software out yet (Maximillian looked promising, but it wasn't compatible with DOS 1.1), and even the games are scarce so far. But with the open architecture and easy access to documentation, I think this will be short-term.

2. The software I do have (especially Lattice) seems to be of the opinion that, since there's lots of memory and disk space, there's no need for efficiency. For instance, the Lattice package takes up an entire 880K disk, with no room for the DOS functions. The familiar "Hello.C" program compiled to 15K. Where, oh where, are the days when you could fit your BASIC graphics program into 4K, with another 4K for the BASIC interpreter and operating system?

**Lloyd Sumpter**

#203 - 1740 Southmere Cres.

White Rock B.C. Canada V4A 6E4

## Tips & Gotchas

In case you didn't know, the Ampro Little Board (and the Big Board, too, for all I know) can talk MIDI with a simple \$10 interface. It can run port B at 31.25Kbps; the rest is a 2mA current loop to RS-232 adaptor using a 6N138 opto (GI sells them for a lot less than HP).

If you're building a bare-board L-Band spooler, be advised that it will need a hardware patch if it's to use TI's TMS4164s. They're 8-bit-refresh 4 millisecond parts; the Z80 holds d7 low during RFSH\* time, so half of each chip never gets a refresh. The board layout is quiet enough (free of electrical crosstalk) to use just about any Japanese 7-bit/2 millisecond RAMs that meet the access time, so why pay the extra? Good product, once I got that bug killed (I used TMS4164s). It's happily sitting in the rack box that holds the Ampro, two SA455s, and

two SA465s, and everybody runs on that switcher that BCD Electro has been selling for \$25. Excellent supply, by the way.

Watch out for solid-state Scientific HCMOS. I've had a couple of bus-killer failures with their 74HC245 (+5 shorted to a data bit). I'm keeping my eye on them. I got the parts from Jameco.

**Carroll R. Bryan III WB1HKU/6**  
7311 Variel Ave #4  
Canoga Park CA 91303

## Reader Comments

As I filled out the Micro C renewal questionnaire, it was difficult to assign ratings to many of the things listed. Even though I gave (for instance) a zero to BBI, I still read most of the articles about the BBI because I often find something of interest in each article. I really read your publication from cover to cover. I'm mainly interested in my Z80 machine and now the 68000 machine. There is already much out there on Unix, so I don't think Micro C should get into that yet. Unix isn't so prevalent in the hobby, do-it-yourself world (yet). It's big and quite complex.

I'd like to see things on 68000 D-I-Y machines, especially S-100, because that's what I have. I would really like to see some articles on CDOS. I'm sure there are people out there with more knowledge than I have about how to get in and do the things that one can do with CP/M such as hard disks (without going to Cromemco).

Speaking of Cromemco, it really frosts me that they don't support CDOS and yet won't release the source code. They've forgotten those of us who bought their machines when they were working out of a garage in San Jose. We had confidence in them and helped make them a reasonably large company (our department at USC bought four machines), and now they turn their backs on us unless we fork over more big bucks. They completely ignore the hobbyists that they themselves were a part of. 'Nuf said.

**Robert L. Amen**  
Chesapeake Bay Institute  
4800 Atwell Rd.  
Shady Side MD 20764



## Digital dynamics

- **NEW** - SEETIME has alarms!  
You can set up to 4 alarms, each containing date, time & message.
- **NEW** - Screen saver feature turns off the screen after a set time with no keyboard activity.
- **NEW** - Configuration program to set SEETIME parameters:
  - time/date location on screen
  - military or civilian display format
  - cursor blinking or steady
  - screen saver timeout
- **SEETIME** can input the time or date into any program, print the screen and display alarms.
- **SEETIME** is part of TIMEPRO:
  - APPT personal schedule manager
  - TD file time/date stamping & backup
  - LOG computer usage logging

TIMEPRO runs on '84 & later Kaypros with Kaypro, Kenmore or Advent clocks..... \$49.95  
SEETIME upgrade for TIMEPRO owners... \$14.95

Shipping and Handling - \$2.50

(206) 772-0291 Visa, MasterCharge  
12448 83rd Ave S., Seattle WA 98178

## INVENTORY CLEARANCE

### EPROM PROGRAMMER

interfaces to the BBI (XEROX 820) parallel port  
Requires +5v. ■ .3A, +25v. ■ .1A, interface cable

Program, Verify, Load and Erase check  
2716, 2816A, 2516, 2732(A), 2532, 2764, 2564, 27128

|   |          |
|---|----------|
| 1. Software and schematic   | 15.00    |
| 2. Bareboard and schematic  | 15.00    |
| 3. Software and bareboard   | 25.00    |
| 4. Software and kit (less ZIFs)                                       | 60.00    |
| 5. Software and full kit  |          |
| 6. Programmer A + T   | SOLD OUT |
| Big Board II software and source (uses BB II sockets for programming) | 15.00    |

### Utility Disk 1

PEG - Universal Object File Translator. Formats supported ...  
8/16 bit Intel and Motorola hex BHLF .COM BPNF ASCII  
Merge and split of 16 bit data also supported.  
HEXED - A full screen hex file editor (simultaneous editing of both hex and ascii)  
Full source and documentation on disk 15.00

### WADE-I

- 256k bytes of RAM with DMA capability
- 4 fully buffered 8 bit parallel ports
- configurable EPROM socket (2716 thru 27256)
- 4 fully buffered 8 bit parallel ports
- 2 configurable RS232C serial ports
- Complete documentation

|                          |       |
|--------------------------|-------|
| 1. Bareboard             | 39.00 |
| 2. Printer buffer EPROM  | 10.00 |
| 3. Printer buffer source | 15.00 |

Specify 8" SSSD or 5.25 Kaypro diskettes \*U.S. FUNDS\* include \$3.00 for S/H

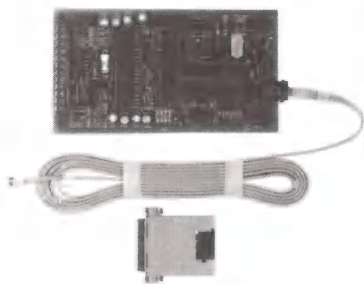
## Biegun and Associates

P.O. Box 4071, Stn "B" Winnipeg, Manitoba  
CANADA R2W 5K8

## MODULAR DISTRIBUTED DATA ACQUISITION SYSTEM

### AD1208

#### DATA ACQUISITION SUBSYSTEM



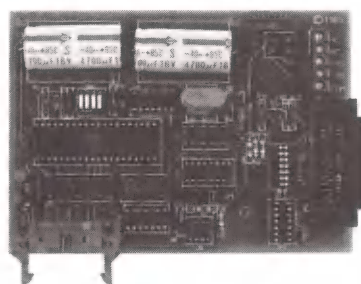
- 8 single ended channels
- 12 bits plus sign resolution
- Input range + - 4.096V standard, + - 4096V optional
- User installable input attenuator option for each channel
- 15 samples/sec sampling rate
- Interfaces to any host via RS232 port 300 to 19200 baud
- Stand alone (requires RS232 to modular jack adapter) or multisystem (connects to MP8000 multiplexer) operation
- Simple one or two character commands from any language (BASIC, PASCAL, ASSEMBLY etc)
- Programming examples included
- Modular interface cable included

Assembled and tested ..... \$199

25 pin RS232 to modular jack adapter kit (specify male or female) ..... \$10.95

### CN100

#### RS232 MULTIPLEXER CONTROLLER

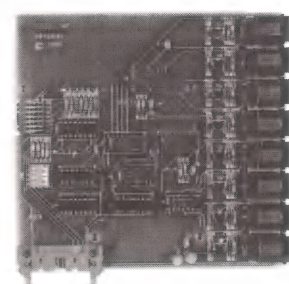


- Connects to host via standard RS232 cable
- 300 to 19200 baud operation
- Controls up to 16 MP8000 multiplexer boards
- Simple two character command from any language (BASIC, PASCAL, ASSEMBLY etc)
- Requires at least one MP8000 multiplexer board for complete RS232 multiplexer

Assembled and tested ..... \$115

### MP8000

#### RS232 MULTIPLEXER



- 8 channel RS232 multiplexer expansion board
- LED numerical display for selected channel
- Easy connection to CN100 via 20 wire ribbon cable expansion bus
- Expandable up to 128 serial channels with one CN100 controller

Assembled and tested ..... \$125

NOTE: CN100 and MP8000 are designed for family of STELCOR Data Acquisition and Control subsystems, but may be used as a general purpose RS232 multiplexer for applications not requiring an active handshake signals.

### STELCOR

P.O. Box 51362  
PALO ALTO, CA 94303  
(415) 968-0558

4 channel analog output plus 16 digital I/O subsystem coming soon

## STELCOR

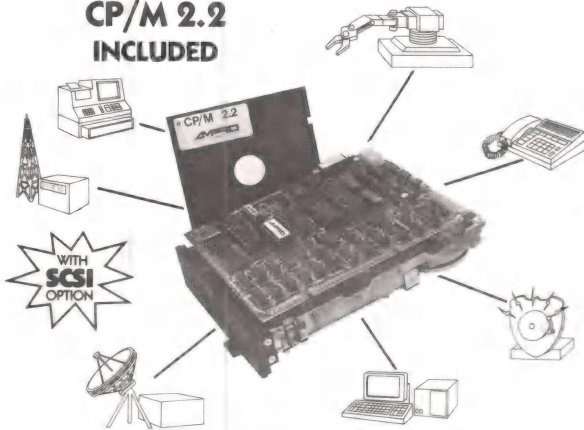
TERMS: Check or Money Order. California residents add 6½% sales tax. Add \$5 for shipment outside USA. Allow 2 weeks for delivery.



# Little Board™ .... \$249

## The World's Least Expensive CP/M Engine

**CP/M 2.2  
INCLUDED**



- 4 MHz Z80A CPU, 64K RAM, Z80A CTC, 4-32K EPROM
- Mini/Micro Floppy Controller (1-4 Drives, Single/Double Density, 1-2 sided 40/80 track)
- 2 RS232C Serial Ports (75-9600 baud & 75-38, 400 baud), 1 Centronics Printer Port
- Power Requirement: +5VDC at .75A; +12VDC at .05A / On board -12V converter
- Only 5.75 x 7.75 inches, mounts directly to a 5-1/4" disk drive
- Comprehensive Software Included:
  - Enhanced CP/M 2.2 operating system with ZCPR3
  - Read/write/format dozens of floppy formats (IBM PC-DOS, KAYPRO, OSBORNE, MORROW...)
  - Menu-based system customization
  - Operator-friendly MENU shell
- OPTIONS:
  - Source Code
  - TurboDOS
  - ZRDOS
  - Hard disk expansion to 60 megabytes
  - SCSI/PLUS™ multi-master I/O expansion bus
  - Local Area Network
  - STD Bus Adapter

## BOOKSHELF™ Series 100

### Fast, Compact, High Quality, Easy-to-use CP/M System



**Priced from  
\$895.00  
10MB System  
Only \$1645.00**

- Ready-to-use professional CP/M computer system
- Works with any RS232C ASCII terminal (not included)
- Network available
- Compact 7.3 x 6.5 x 10.5 inches, 12.5 pounds, all-metal construction
- Powerful and Versatile:
  - Based on Little Board single-board computer
  - One or two 400 or 800 KB floppy drives
  - 10-MB internal hard disk drive option
- Comprehensive Software Included:
  - Enhanced CP/M operating system with ZCPR3
  - Word processing, spreadsheet, relational database, spelling checker, and data encrypt/decrypt (T/MAKER III™)
  - Operator-friendly shells; Menu, Friendly™
  - Read/write and format dozens of floppy formats (IBM PC-DOS, KAYPRO, OSBORNE, MORROW...)
  - Menu-based system customization

#### DISTRIBUTORS

**ARGENTINA:** FACTORIAL, S.A., (1) 41-0018, TLX 22-408 **BELGIUM:** CENTRE ELECTRONIQUE LEMPEUR, (041) 23-4541, TLX 42621 **CANADA:** DYNACOMP COMPUTER SYSTEMS LTD., (604) 879-7737 **ENGLAND:** QUANT SYSTEMS, (01) 953-8423, TLX 946240 REF:19003131 **FRANCE:** EGAL+, (1) 502-1800, TLX 620893 **SPAIN:** XENIOS INFORMATICA, 593-0822, TLX 50364 **AUSTRALIA:** ASP

**MICROCOMPUTERS:** (613) 500-0628 **BRAZIL:** CNC-DATA LEADER LTDA., (41) 968-9262, TLX 041-6364 **DENMARK:** DANBIT, (03) 66-20-20, TLX 43558 **FINLAND:** SYMMETRIC OY, (0) 585-392, TLX 121394 **ISRAEL:** ALPHA TERMINALS, LTD., (3) 49-16-95, TLX 341667 **SWEDEN:** AB AKTA, (08) 54-20-20, TLX 13702 **USA:** CONTACT AMPRO COMPUTERS INC., TEL: (415) 962-0230 TELEX: 4940302

IBM®, IBM Corp.; Z80A®, Zilog, Inc.; CP/M®, Digital Research; ZCPR3™ & ZRDOS™, Echelon, Inc.; Turbo DOS™, Software 2000, Inc.; T/MAKER III™, T/Maker Co.

**AZTEC**  
COMPUTERS, INCORPORATED

67 East Evelyn Ave. • Mountain View, CA 94041 • (415) 962-0230 • TELEX 4940302

## EDITORIAL

(continued from page 2)

arena. (Our \$3,000+ Kaypro 286i isn't perceptibly faster and its AT style floppy/winnie controller has been a pain.)

The only thing I miss on the Holliston board (and on Gary's X-16 board) is the math co-processor. However, both Holliston and PC Tech are supposed to be finishing 8087 upgrades as I write this.

Holliston's will be an add-on board, PC Tech's 8087 will mount directly on their latest version of the processor board.

### Floating Point Speed

It was The Culture Corner problem in Issue 29 that graphically pointed out the value of hardware floating point. (The problem was to find four numbers whose sum and product is 7.11.) I could have substituted integers for floats in this problem, but that kind of substitution wouldn't have worked in most other floating point situations.

I used a brute force method to search for the answer, which means that my program does lots of floating point operations.

Let's see, to test every possible number between 0 and 711 to see if its sum and product were equal it would take 711 X 711 X 711 X 711 passes. The program would do addition and multiplication of four floating point numbers in addition to numerous floating increments (much better than sinking increments) and floating comparisons.

I whittled the number of passes down significantly (to about 355 X 355 X 355) which made the times at least workable.

Peter Casey (the C instructor who suggested the problem) tried running his brute force version on the college's PDP 11. After an overnight grind and no solution he gave up (they charge his account for each minute of CPU time).

I told him that I'd fire up a clone and see what I could come up with. Check out The Culture Corner for the solution and the next problem (chuckle, chuckle). And though my method was not elegant (I was not properly primed for this one), I did get the answer and a kind of perverse pleasure watching the systems struggle along. (All except the DSI system.)

The C source was the same. The 8088 code was generated by Aztec C (I used the 8087 library to get the 8087 times). The DSI version was compiled under Green Hills C. The times are shown in Figure 1.

The V20 system we used is a speeded-up Sky High clone in which we installed a V20 and switchable 22MHz and 14.31818MHz master crystals.

I know, I didn't tell you that you could use a 22MHz crystal. You can, if you're lucky. We haven't, however, gotten any clones to go 8MHz (24MHz crystal). At least not yet.



## Puzzles

Speaking of puzzles, we're getting a delightful number of really interesting responses to the puzzle in The Culture Corner in Issue 29. Again, see The Culture Corner for the solution to our insolvable product. One intrepid soul found the solution in under 27 min. 12 sec. using only paper and pencil. (Definitely not artificial intelligence.)

I'm looking for more such problems that we can solve. We received one for this issue, but we definitely want more, more, more. Look, in my spare time I'm either solving puzzles or making the editorial longer. It's your choice.

## The Real Winner

Meanwhile, my brute force solution pointed out the value of a good floating point co-processor. National's floating point chip is obviously the fastest thing since the Turbo Porsche. (What, another Borland product?)

On the other hand, you can add a crystal, a V20, and an 8087 (get the 8MHz version) to a pokey little clone and do quite well. (Just be sure that the compiler you're using supports the 8087.) Also, take a look at Trevor's article in this issue for information on Motorola's new 68881 floating point co-processor.

Anyway, you can see why the DSI board has been so popular with the universities. Research data is usually of the floating point variety, and crunching floats is usually either slow (in software) or expensive.

In fact, one of the reasons IBM chose the 8086 series for the PC was the availability of the 8087. Though Motorola has had the 68000 out for a long time, it has had a devil of a time making the 68000's math chip go. (Math chips are about three times as complex as their CPU partners.)

## Time

Speaking of system speed, I've recently discovered that time is only relative (my mother, who is about as relative as anyone I know, has no doubt mentioned this to me from time to time). It turns out that when you speed up

(continued next page)

Figure 1 - Puzzle Solution Times

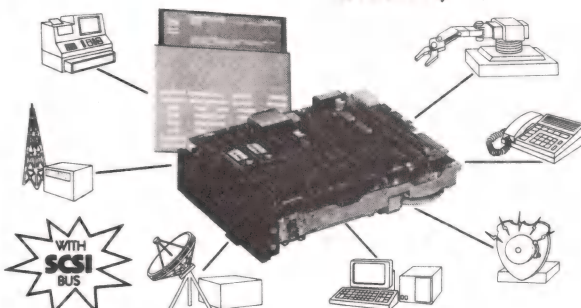
| System          | time to solution: | FP proc.? |
|-----------------|-------------------|-----------|
| DSI-32          | 27 min 12 sec     | yes       |
| XT-186 8MHz 186 | 9 hrs 43 min      | no        |
| 7.33 MHz V20    | 2 hrs 56 min      | yes       |
| 7.33 MHz V20    | 15 hrs 49 min     | no        |
| 4.77 MHz V20    | 4 hrs 31 min      | yes       |
| 4.77 MHz V20    | 24 hrs 19 min     | no        |
| 4.77 MHz 8088   | 41 hrs 18 min*    | no        |

\* The 8088's time was calculated from its performance relative to V20 in a similar (but much shorter) program. There's a limit to the amount of perverse pleasure I can stand.

# Little Board™/186....\$495

## High Performance, Low Cost PC-DOS Engine

Boots IBM PC-DOS  
(not included)



- Three times the COMPUTING POWER of a PC
- Data and File Compatible with IBM PC, runs "MS-DOS generic" programs
- 8 MHz 80186 CPU, DMA, Counter/Timers, 128/512K RAM zero wait states, 16-128K EPROM
- Mini/Micro Floppy Controller (1-4 Drives, Single/Double Density, 1-2 sided, 40/80 track)
- 2 RS232C Serial Ports (50 -38,400 baud), 1 Centronics Printer Port
- Only 5.75 x 7.75 inches, mounts directly to a 5-1/4" disk drive
- Power Requirement: +5VDC at 1.25A; +12VDC at .05A; On board -12V converter
- SCSI/PLUS™ multi-master I/O expansion bus
- Software Included:
  - PC-DOS compatible ROM-BIOS boots DOS 2.x and 3.x
  - Hard Disk support
- OPTIONS:
  - Expansion board with:
    - 128 or 512K additional RAM
    - 2 Sync/Async RS232C/422 serial ports
    - Battery backed Real Time Clock
    - 8087 Math Co-Processor
    - Buffered I/O Bus
  - STD Bus Adapter
  - Utilities source code
  - TurboDOS / Networking

## BOOKSHELF™ Series 200

### Fast, compact, high quality, versatile PC-DOS system



Three times the COMPUTING POWER of a PC

**Priced from**  
**\$1295.00**  
**10MB System**  
**Only \$1945.00**

- Data and File compatible with IBM PC-DOS 2.x and 3.x
- Runs "MS-DOS generic" programs (Dbase II, Multiplan, Wordstar, SuperCalc 2, Turbo Pascal, Fortran 77, Microsoft C, Lattice C, IBM Macro Assembler, Intel compilers & tools, GW Basic, etc.....)
- Works with any RS232C ASCII terminal (not included)
- Compact 7.3 x 6.5 x 10.5 inches, 12.5 pounds, all metal construction
- Based on Little Board/186
  - 512K RAM, no wait states
  - Two RS232C serial ports
  - One Centronics printer port
- One or two 360 Kb floppy drives
- 10MB internal hard disk drive option
- Software Included:
  - PC-DOS Compatible ROM-BIOS boots DOS 2.x and 3.x
  - Hard Disk Support
  - T/Maker III — Word processing, spreadsheet, relational database, spelling checker, and data encrypt/decrypt
- Expandable:
  - Floppy expansion to four drives
  - Hard disk and tape expansion
  - SCSI/PLUS™ multi-master I/O expansion bus

### DISTRIBUTORS

ARGENTINA: FACTORIAL, S.A., (1) 41-0018, TLX 22408 BELGIUM: CENTRE ELECTRONIQUE LEMPEREUR, (041) 23-4541, TLX 42621 CANADA: DYNACOMP COMPUTER SYSTEMS LTD., (604) 872-7737 ENGLAND: QUANT SYSTEMS, (01) 923-8423, TLX 946240 REF:19003131 FRANCE: EGAL+, (1) 502-1800, TLX 620893 SPAIN: XENIOS INFORMATICA, 593-0822, TLX 50364 AUSTRALIA: ASP MICROCOMPUTERS, (613) 500-0628 BRAZIL: CNC-DATA LEADER LTDA, (41) 268-9962, TLX 041-6364 DENMARK: DANBIT, (03) 66-90-90, TLX 43558 FINLAND: SYMMETRIC OY, (0) 585-392, TLX 121394 ISRAEL: ALPHA TERMINALS, LTD., (3) 49-16-95, TLX 341667 SWEDEN: AB AKTA, (08) 54-20-20, TLX 13702 USA: CONTACT AMPRO COMPUTERS INC., TEL: (415) 962-0230 TELEX: 4940302

**AMPRO**  
COMPUTERS, INCORPORATED

67 East Evelyn Ave. • Mountain View, CA 94041 • (415) 962-0230 • TELEX 4940302



# EXPAND YOUR Productivity

CP/M

MS DOS

**New:** The NEC V-20 improved 8088 Microprocessor (8mhz) — 10-45% increase in speed — just plug it in — MS DOS only .....\$25.00

## Increase Memory...

1. Kaypro 16 256K-512K Memory Expansion .....\$69.95
2. Kaypro PC 256K-640K Memory Expansion .....\$69.95

Both are simple plug-in installations; includes public domain RAM Disk software and other utility programs

## Increase Visibility...

1. **Composite Video Generator** adds standard composite monitor to a Kaypro II or IV .....~~\$49.95~~ \$44.95
2. **Composite Video Generator** adds an unmodified composite monitor for Kaypro 1, 2-84, 2X, 4-84, 10 .....~~\$89.95~~ \$84.95
3. **External Monitor Adapter** adds a TTL monitor to a Kaypro 1, 2-84, 2X, 4-84, 10 .....~~\$49.95~~ \$44.95

## Increase Programming Tools...

1. **Color Graphics Board** gives 16 colors, 32 sprites w/bit-mapped graphics; requires external monitor or TV; for any CP/M Kaypro .....~~\$145.00~~ \$130.00
2. **Deluxe TLC Logo** "turtle" graphics language; for use with color graphics board .....\$129.95
3. **Color Board and Deluxe Logo package** .....~~199.95~~ \$179.95
4. **Instant Grapher 2.1** gives labeled bar and line graphs; prints separate pattern for each color; use with color board only .....~~\$49.00~~ \$29.95
5. **Standard TLC Logo** "turtle" graphics language uses internal graphics of Kaypro 1, 2-84, 2X, 4-84, 10 .....~~\$99.00~~ \$79.00

## Increase Speed...

1. **Electronic RAM Disk and Printer Buffer Combination** — the ultimate add-on for Kaypro I, II, IV, 2X, 2-84, 4-84 & 10 computers. No longer will you need to wait for your Kaypro to slowly finish mundane tasks such as running a printer or waiting for floppy drives to turn when you have better things to do.

|  |          |
|--|----------|
| Tested RAM Disk without RAM chips..... | \$245.00 |
| 256K RAM Disk .....                    | \$295.00 |
| 512K RAM Disk .....                    | \$345.00 |
| 768K RAM Disk .....                    | \$395.00 |
| 1MB RAM Disk .....                     | \$445.00 |

\* Prices include all installation materials except for P10 Adapter Board required for Kaypro 10 w/out an external modem and optional on 1, 2-84, 2X, and 4-84.

2. **Kaypro II to IV Upgrade** includes 2.5 Mhz to 5 Mhz speed up, two 390K disk drives (DSDD) to replace the single sided drives; price does not include shipping. ....\$395.00

**NOW INCLUDED WITH RAM DISK:** Parts layout, schematic and instructions to build a battery back-up power supply for the RAM Disk.

CATALOG and COMPLETE DESCRIPTIONS AVAILABLE  
100's OF SOFTWARE LISTINGS FOR CP/M NOW AVAILABLE

MicroSphere, Inc.  
P.O. Box 1221  
Bend, Oregon 97709  
503-388-1194



## EDITORIAL

(continued from page 91)

an XT clone you also speed up its clock — that is, the hours, minutes, and seconds variety.

Some people have called and complained: "Hey, the time isn't right any more." (Only the system clock speeds up — a battery-backed real-time clock will be oblivious to the change.)

What they're really saying is that time is different, it's faster. Stop for a (6.67MHz) moment and consider the possibilities.

Let's say you have an 8-hour per day job compiling software. All you have to do is speed up your system and use it for both your compilations and to keep track of your time. You'll get the same amount of compilation done, but the day will go faster.

With your system running a mere 6.67MHz you could be out enjoying the outdoors in under six (4.77MHz) hours. With a 23MHz RISC processor, you might just have time for one pass and lunch (1 hr, 39 minutes) before streaking home.

Of course, you couldn't have your timer running at 23MHz all the time. After all, two-hour movies would last about four commercials and a station break (sometimes that happens already). Weekends would take about 10 hours flat. (I wonder what effect this would have on the space-time continuum.)

So you need two systems — a fast one for work, a really slow one at home, which probably explains why Apples have been so popular as home computers.

## PROLOG

Borland has been developing PROLOG for the last 2 1/2 years, and it's been the best kept secret that I haven't been privy to. I pride myself with keeping my ear pretty close to the ground (so moles can whisper in it) and all I'd gotten on this one was a dirty ear canal.

Anyway, one week Philippe called AI "so much bunk and rubbish" and the next week he announced PROLOG. He figures he'll sell ten times as many copies of PROLOG as Pascal. That means about 5 million copies! At \$100 each!

## AI

Much of the problem with AI is that people have expected too much. Even the name has something magically unreal about it. If it's going to be magic, let's make really good magic. Let's have AI understand the spoken word (even though humans can't do that after years of training).

With AI, computers should be able to solve problems (such as playing chess) more efficiently as they learn to deduce specific responses from general rules and create general rules from more specific experiences.

Of course, anyone who's seen 2001 knows exactly what AI will be able to do.

"Hello, David. How are you today?"



'I'm fine, Hal.'

"Does that mean that you had no parity errors this morning, Dave?"

'Not that I can recall, Hal.'

Our expectations for smart computers have come from the science fiction writers, and the writers have, so far, avoided the fetters of reality. When reality intrudes, AI has problems.

In real time, we're limited to poking around the edges. The computer needs senses and it needs a method for thinking.

For the senses, we are working on speech recognition, pattern recognition, odor detectors, ultrasonic positioning information, etc. For the thought, we are using languages like PROLOG to create giant condition tables.

If this is Wednesday,  
and  
I'm still with the tour group,  
and  
a car bomb hasn't blown up my hotel,  
and  
our plane wasn't hijacked,  
then  
this must be Dallas.

But thought? No. Computers aren't really thinking. At least not like people. And cognition isn't something that will be solved by more speed or more memory. It will be solved when cognition understands itself.

#### Where To For Micro C?

MS-DOS people complain that we're still just a CP/M magazine. CP/M people complain that we've become another PC rag. Well, we're a CP/M magazine becoming an 8086 magazine, a 68000 magazine, a hardware magazine, a software magazine, an AI magazine, a fun magazine, a serious magazine, and a CP/M magazine. And through it all we'll remain a build-it, prod-it, poke-around-in-it, SOGing, and puzzling kind of journal.

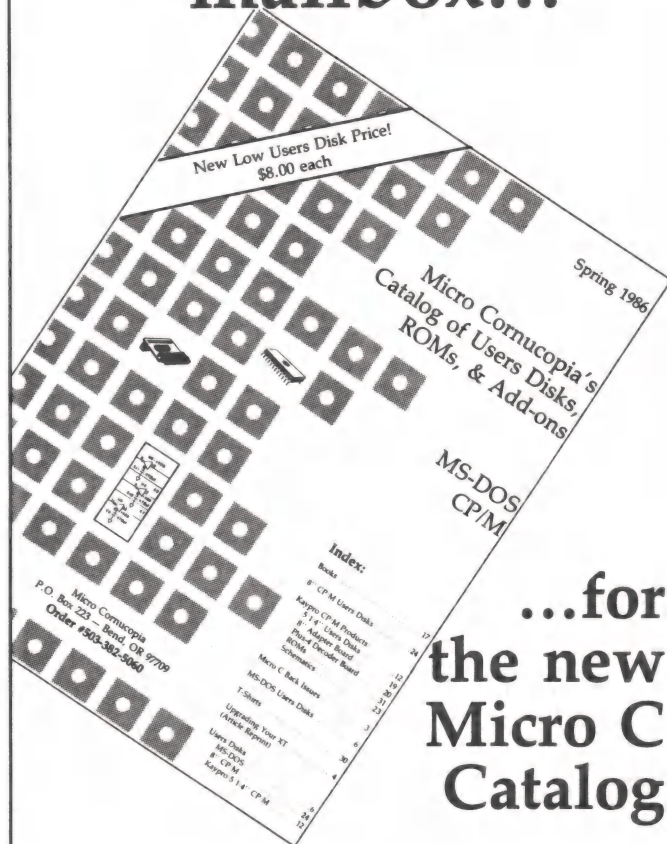
#### SOG

Meanwhile, if you're coming to SOG V, great. You'll be in super company. Calls and letters are pouring in from prospective attendees.

The event is free and it's really the high point of our year. I hope you'll plan to join us. See the SOG page in this issue for more information.



# Watch your mailbox...



## ...for the new Micro C Catalog

If you are a subscriber or have ordered recently you'll be receiving the new catalog. If you don't receive one give us a call.

### Including these new MS-DOS disks:

#### MS-20 From The Pascal Runoff (1)

Foreign language vocabulary builder, fractal geometry graphics, and hard disk tree directory programs (all with source).

#### MS-21 Small C and C Windows

C compiler with source and 2 window building programs with source.

#### MS-22 Dynamite Utilities

CP/M emulator, Turbo Pascal inline & resident building programs (with source), step rate mod for drives, and the secret system.

#### MS-23 EXPRESS

Laine and Cecil Stump's speedy little programmer's editor (best editor deal in the public domain).

**Micro  
Cornucopia**

P.O. Box 223  
Bend, OR 97709



Order #503-382-5060





# Fast Step Rate For PC Disk Drives

By Larry Fogg

Micro C Staff

*Anything worthwhile requires effort. In this case, however, Larry has found something very worthwhile that requires almost no effort at all. So, stepping right along...*

In recent issues we've shown how to speed up the disk drive step rate for CP/M Kaypros. Now it's time for a Personal Clone version. But first, put down those soldering irons! This is a job for software.

## Why Bother?

There are two benefits from changing the step rate. The obvious one is faster disk accesses. The CRC of a full disk went five percent faster when I cut the step rate from 8ms to 4ms.

But just as important is quieter drive operation. The neighborhood dogs used to surround my house and howl at the drives as they ground their way through long compilations. Now I can nap contentedly at the keyboard during even the wildest disk activity.

## DPT Surgery

In order to change the step rate you'll need to perform a little surgery on the disk parameter table (DPT). This table contains a wealth of information on disk drive characteristics (see Table 1 for a complete description).

The first nibble (four bits) of the DPT determines the step rate. Hex values of C, D, E, and F give step rates of 8, 6, 4, and 2ms.

Presumably a value of G would yield a 0ms step rate and the fastest drives in town. 8ms is used by both the IBM BIOS and the Z-NIX BIOS which came with my clone. Teac 55BVs will run at 4ms while Mitsubishi 4851s are happy all the way down to 2ms. Experiment with your drives to find the best step rate.

The easiest way to change the con-

tents of the step rate nibble is to enter a little assembler routine with DEBUG. See Listing 1 for this procedure.

Note that the segment has been shown as ????, because DEBUG chooses a value for CS which will vary according to the configuration of your system. It's not really important what that value is. Also, don't add a trailing 'h' to any numbers. DEBUG assumes hex values and will be offended by your attempts to be explicit. Once the program has been saved it can be added to your AUTOEXEC.BAT file for execution on cold boot.

## More Experiments

I've read that altering the head settling time can improve disk performance, but I saw no change at all using a range of values from 0 to 40.

Try experimenting with head settling and other parameters in the DPT as well. With a little creativity you can get yourself into all sorts of trouble. (What fun would it be otherwise.) So there you have it — quick, quiet drives without the need to molest your hardware.



Listing 1 - Assembler Routine

```
B>DEBUG
-A                               ; invoke DEBUG's assembler
????:0100 XOR AX,AX              ; set AX register to 0
????:0102 MOV DS,AX             ; data segment starts at 0
????:0104 MOV BX,522            ; 522 is the offset of the DPT
????:0107 MOV BYTE PTR [BX],EF ; move new step rate (4 msec) into DPT
????:010A INT 20                ; return to DOS
????:010C                        ; <cr> here exits assembler mode
-NFASTSTEP.COM                  ; name file and set up FCB
-RCX                             ; CX register must get file length
CX 0000                          ; current value in CX
:C                               ; change to C (file is C bytes long)
-W                               ; write the file to disk
Writing 000C bytes
-Q                               ; quit DEBUG
```

Table 1 - Disk Parameter Table

| Byte | Action  | IBM Value |
|------|---|-----------|
| 1    | high order=step rate      low order=head unload time    | CF        |
| 2    | high order=head load time      low order=mode (DMA)     | 02        |
| 3    | delay for turning motor off                             | 37        |
| 4    | sector size in bytes ( 0=128   1=256   2=512   3=1024 ) | 02        |
| 5    | last sector number on a track                           | 08        |
| 6    | gap length between sectors                              | 2A        |
| 7    | data length   | FF        |
| 8    | gap length for use in format                            | 50        |
| 9    | fill byte ( written to disk during format )             | F6        |
| 10   | delay for head settling ( in milliseconds )             | 25        |
| 11   | delay for motor start-up ( in 1/8 seconds )             | 04        |



## DISK DRIVES

**3.5" EPSON SMD 100** ..... \$89.00

- DOUBLE SIDED, 1 MB UNFORMATTED
- HARDWARE COMPATIBLE WITH 5-1/4" 96 TPI DRIVES
- WITHOUT FRONT PANEL

**5-1/4" OKIDATA HALF HEIGHT** ..... \$89.95

- 48 TPI
- DOUBLE SIDED
- 360 KB FORMATTED CAPACITY
- IBM COMPATIBLE

**5-1/4" OKIDATA 1/3 HEIGHT** ..... \$89.95

- 48 TPI
- DOUBLE SIDED
- 360 KB FORMATTED CAPACITY
- IBM COMPATIBLE

**5-1/4" TEC FB504** ..... \$95.00

- 96 TPI HALF HEIGHT
- DOUBLE SIDED
- 720 KB FORMATTED CAPACITY
- QUIET!
- RUNS ON IBM XT WITH J FORMAT SOFTWARE (NOT SUPPLIED)

**8" SHUGART SA801R** ..... \$179.00

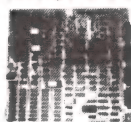
- FULL HEIGHT
- SINGLE SIDED
- 600 KB FORMATTED CAPACITY
- BRAND NEW! NOT RECONDITIONED



## TELEVIDEO TS804

**Main Logic Board** ..... \$75.00

- CP/M 4 USER COMPUTER
- COMPLETE WITH ALL IC'S & RAM
- TESTED GOOD



## TELEVIDEO TS1603

**Main Logic Board** ..... \$75.00

- CP/M 86 OR MS-DOS COMPUTER
- COMPLETE WITH ALL IC'S & RAM
- TESTED GOOD

**HALTED SPECIALTIES** offers unique super-market style shopping for your electronic needs. We stock thousands of parts, from the newest IC's to some of the first transistors. We also have computer accessories and test equipment.

### 3 Convenient Locations

HSC Electronic Supply  
5549 Hemlock St.  
Sacramento, CA  
(916) 338-2545

Halted Specialties  
827 E. Evelyn Ave.  
Sunnyvale, CA  
(408) 732-1573

HSC Electronic Supply of Santa Rosa  
(Opening May 31)  
6819 S. Santa Rosa Ave.  
Cotati, CA (707) 792-2357



## IBM\* COMPATIBLES

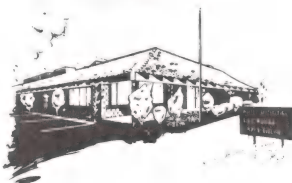
All of our IBM\* Compatible Products were carefully tested and chosen for full compatibility.

|                                |          |
|--------------------------------|----------|
| FLIP TOP CASE                  | \$ 49.95 |
| 130 W POWER SUPPLY             | \$ 89.95 |
| 150 W POWER SUPPLY             | \$ 99.00 |
| KEYBOARD DKM 2000              | \$ 79.95 |
| KEYBOARD KB 5151 (Enhanced)    | \$ 99.00 |
| 640K XT* MOTHERBOARD (0K RAM)  | \$159.00 |
| BIOS ROM (SIDEKICK COMPATIBLE) | \$ 29.95 |
| MULTI I/O W/ FDD CONT          | \$129.95 |
| COLOR GRAPHICS CARD            | \$ 99.95 |
| MONOCHROME CARD                | \$119.95 |
| MULTIFUNCTION CARD             | \$129.95 |
| FLOPPY CONTROLLER              | \$ 49.95 |
| HARD DISK CONTROLLER           | \$175.00 |
| INTERNAL 1200 BAUD MODEM       | \$199.00 |
| 2 MB RAM EXPANSION FOR XT*     | \$199.00 |
| 3 MB MULTIFUNCTION CARD FOR    |          |
| IBM AT* WITH 0K RAM            | \$225.00 |
| EPROM PROGRAMMER (27xxx)       | \$129.95 |
| EGA CARD (IBM* COMPATIBLE)     | \$295.00 |

\*XT, AT and IBM are Registered Trademarks of International Business Machines Corp.

## ACCESSORIES

|                                |               |
|--------------------------------|---------------|
| Parallel printer cable         | \$ 9.95       |
| Swivel monitor stand           | \$12.95       |
| Y power cable for disk drive   | \$ 2.95       |
| NEC V20 processor 5mhz. (8088) | \$19.95       |
| NEC V20 processor 8mhz. (8088) | \$24.95       |
| 4164 150 ns 64K ram chips      | 9 for \$10.71 |
| 41256 150 ns 256K ram chips    | 9 for \$31.41 |
| NEC V30 processor 8mhz. (8086) | \$25.00       |
| 8087 math coprocessor          | \$139.00      |



# HALTED SPECIALTIES co., inc.

827 E. EVELYN AVE. SUNNYVALE, CA., 94086

(408) 732-1573

WE SHIP C.O.D.

### Store Hours:

Mon.-Fri. 8:00-7:00  
Saturday 9:00-5:00

In Sacramento Call  
(916) 338-2545

**TERMS:** Minimum order \$10.00. California residents add 6-1/2% sales tax. Prepaid orders sent freight C.O.D. or call for charges, shipping will be added to credit card and C.O.D. orders. Prepaid orders over \$100.00 use money order or certified check. Please do not send cash. Some items limited to stock on hand. Prices subject to change.



## Big Board II Tips

I've made a couple of changes to my BBII that other readers might find interesting.

The first problem I had was with the power-on reset. Half the time on power up (or if there was a glitch in the power line) the processor wouldn't reset properly. To make things worse, the reset button didn't work either due to the lack of an M1 cycle. So I decided to fix it once and for all.

The circuit diagram shown below was built in the bread board area of the BBII. The main feature is that the TI7705A senses the +5V line and doesn't start its delay until the +5V line is > 4.75V. Also, if it drops below 4.75V, the chip will start a reset cycle. Since I installed this circuit I have not had a single problem.

While I was at it, I also modified the clock circuit a bit. I changed U19 (a 74LS04) to a 74HC04. This cleaned up the drive waveform tremendously and decreased its rise time due to the larger dynamic range of the CMOS part.

**Ken Carlson**  
1206 SE 140th Ave.  
Vancouver WA 98684

## 25th Line Blues Fix

After installing the Pro-884 and the 8" drive adapter board in my Kaypro 4-84, and enabling the 25th line for time and date, I noticed that for approximately 15 minutes after turn on, the 25th line randomly filled with graphic characters. After 15 minutes everything worked okay (obviously heat related).

My solution? Using a heat gun and a can of quick freeze, I found that the octal latches U13 and U14 were the culprits. They are located on the main board near the rear left corner. They're both 74LS373s and cost about \$1 from JIM-PACK.

The small program shown below will clear and restore the 25th line at any time.

**Edward J. Pierce**  
310 Hemingway Dr.  
Bel Air MD 21014

## Kaypro Cursor Location

We recently got a call from Richard Hudson wanting to know how to find the cursor value storage location on his Kaypro II and then alter the cursor.

Here's what we suggested: find the storage location for the cursor type using DDT; change the value with CONFIG 83; then go back and look at that location. If the value hasn't changed, you weren't at the right address. (This is obviously a hit and miss technique.) If the value has changed, a short BASIC program to poke the cursor value, or an assembler

program to load the value, will do the trick.

(For those of you with Pro 8s on your system, the cursor change is easy. Type Esc C followed by the character you want for the cursor.)

Richard wrote back to us a short time later to say that he'd found the storage location at FE91h (this is true only for a standard Kaypro II BIOS). Poking 1Fh restored the block. He also mentioned that much of the new public domain software seems to alter his cursor.

**Micro C Staff**

Figure 1 - New Big Board II Reset Circuit

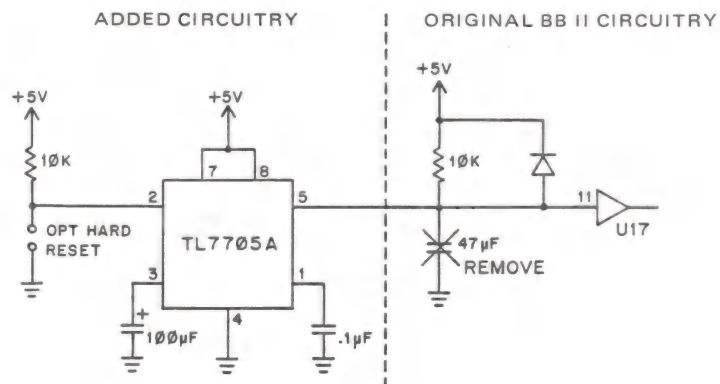


Figure 2 - Status Line Maintenance Program

```
;This program will clear the 25th (status) line on
;the Kaypro, and restore the date-time display.
;Call it on exit from various programs.
;
; Version 1.0      Written by
; 12 Sep 85      E.J. Pierce
;
ESC EQU 1BH
BDOS EQU 5
;
START ORG 100H
MVI C,9 ;save cursor position 1st
LXI D,SAVEC
CALL BDOS
MVI C,9 ;console out
LXI D,MSG ;the clear routine
CALL BDOS ;do it!
MVI C,9 ;restore cursor
LXI D,RESTC
CALL BDOS
JMP 0 ;return
;
MSG DB ESC,'C7',ESC,'B7',ESC,'B8','$'
SAVEC DB ESC,'B6','$'
RESTC DB ESC,'C6','$'
;so be it.
```



### CP/M Turbo Pascal V3.00A Patch

Tired of saying YES (or NO) to Turbo's "Include error messages (Y/N)?" If you are, then use this patch to have Turbo always (or never) load the TURBO.MSG file. Use DDT to load a copy of your compiler (TURBO.COM) into memory. Then simply change the three bytes at locations 222Ch-222Eh. To have Turbo always load the error messages, change as follows:

222C CD -> AF

222D 21 -> 3D

222E 2D -> 00

To have Turbo never load the error messages, change as follows:

222C CD -> AF

222D 21 -> 00

222E 2D -> 00

Then exit DDT and do a "save 121 <filename.com>". After you verify that the change works and the compiler is intact, rename the file "TURBO.COM" for your working disk.

**D.K. Smith**

1747 Attridge Rd.

Churchville NY 14428

### Fixing 1 Meg RAMdisk

The new BI/820-1M one megabyte board for the Big Board recently advertised by Jim Ferguson in Micro C doesn't work as shipped. If you write a byte at 4000H, for example, it will read back at 8000H, and so on for other banks. There is a pin inversion on the schematics and on the printed circuit board at (U43-4, U43-5), (U46-4, U46-5).

For U43 and U46: RA is pin 5, RB is pin 4. To correct the problem, do the following:

1. Cut the trace on top of the board, from U44-9 to the hole.
2. Cut the trace under the board, from U44-11 to the hole.
3. Jumper (under the board) U44-11 to the hole that was going to U44-9.
4. Jumper (under the board) U44-9 to the hole that was going to U44-11.

Note that this new board, as well as the old 256K board, works perfectly at 6MHz with 150ns DRAMs.

**Guy Royer**

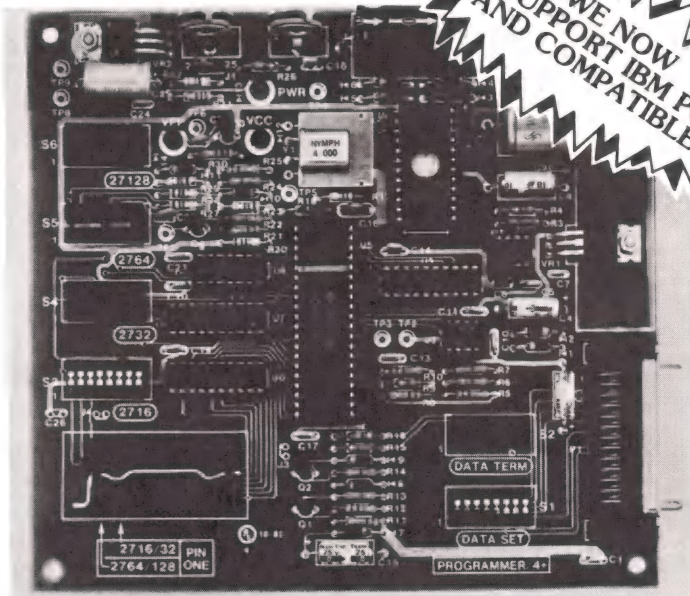
2828 Le Noblet

Sainte-Foy Quebec Canada G1V 2E7



## PROGRAMMER/4+

WE NOW  
SUPPORT IBM PC  
AND COMPATIBLES



### A LOW COST ALTERNATIVE TO EPROM PROGRAMMING

Reads and programs 2716, 2732, 2764, and 27128 EPROMs.

Reads 2-16K ROMs.

Direct connect to any RS232C terminal or computer.

Plug selectable as either a data set or data terminal.

All voltages made on board, (no power supplies needed).

(User supplies power Xformer, 25.2 to 30 VAC C.T.1 Amp.).

Power electronically switched, (can't damage EPROMs).

Zero insertion force socket for EPROM.

Programs, verifies, and dumps in both ASCII and hex.

Edit buffer (like DDT).

Saves hex and/or image files to and from disk.

Saves or loads all or partial buffer.

Completely menu driven for ease of operation.

Commands of Test, Read, Display, Save, Load, Program and more.

Check sum calculation.

All software on disk including well commented source code.

Detailed owners manual including schematic

All chips socketed.

Not a kit! Completely built and tested.

48 hour dynamic burn-in and test before shipment.

90 day limited warranty on parts and workmanship.

24 hour return policy on repairs.

Delivery from stock.

**PROGRAMMER 4+ WITH OWNERS MANUAL AND DISK. \$199.95**

**MS-DOS DISK ONLY \$15.00**

Order from

**periphco**  
1659 Scott Blvd., Suite 1  
Santa Clara, CA 95050  
(408) 354-5084

VISA and MASTERCARD telephone orders welcome.

Please specify Disk format

CP/M 8" IBM format, KAYPRO II, XEROX 820, OSBORNE I, others.

Please specify method of shipment, UPS or Postal Service.  
California residents add 6% Sales Tax. Dealer Inquiries invited.



## But It's On That Disk, I Know It!

### File Recovery In MS-DOS

Every now and then, no matter how conscientious I think I've been, I forget to back up a working disk. Most recently, my forgetfulness began to haunt me just after I'd accumulated a dozen articles for this issue of Micro C.

Naturally, I didn't know I'd been forgetful (negligent is too strong a word!) until my disk failed to respond to a prompt. "Disk error reading drive B:", DOS reported. "Abort, Retry, Ignore?". I tried all three with equal success.

Then I tried several utilities (DEBUG, EASY-ZAP, CHKDSK) and equalled my previous success, concluding that I had a problem.

Track 0, Side 1, Sector 6, the first sector of the directory, was shot, caput, incapacitated, out-to-lunch. It was no laughing matter.

The problem is that most programs capable of reading disk sectors succeed only when they can access directory or file allocation data, and that was precisely what I didn't have.

I needed a program which bypassed the directory and file allocation table and checked each sector directly. Fortunately, I found just the program (if I'd had to write a program to rescue my text, Issue #30 would have undoubtedly followed #31).

SSAR (for Special-Search-And-Recovery) came to my rescue. It's one of the Norton Utilities, and although

limited (it only recovers text), it solved my problem.

When it finds text, SSAR transfers it to a special file on a disk in drive b. The transferred data is marked with sector and end-of-file boundaries, making it easier to reconstruct files.

So I put it to work, and 25 minutes later (yes, it does take time to recover from forgetfulness) I had a text file 227K long ready for editing.

Relieved? You bet I was.

For more information contact —

Peter Norton  
2210 Wilshire Blvd  
Santa Monica CA 90403  
213-349-3948

\$50 (whole set)

## MODULA-2

### DEVELOPMENT BUILDING BLOCKS

#### REPertoire, from PMI. High-performance tools.

Screen display system. Multi-window editor.

Full source, so your programs can follow when you change machines.

#### Screen System.

REPertoire won't bloat your programs because it doesn't generate code. Create screens exactly as they will look, then compress them into one dense, rapid-access file. REPertoire lets your program display a screen instantly in any window with a single function call. Screens check user input, scroll within windows, give context-sensitive help, and conditionally branch to other screens using natural-language analysis functions that you imbed in the screens.

#### Editor.

REPertoire's full-screen multi-window editor fits neatly into your programs. It lets your users create and edit multiple files concurrently.

#### High-Performance Low level Routines.

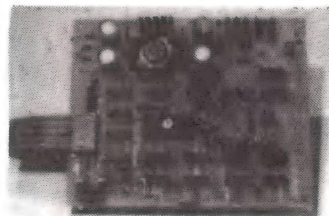
REPertoire provides improved DOS and BIOS access, speaker control, string tools, list handling, and a sample directory manager.

Excellent for educational software or any other screen-intensive application. For IBM compatibles. Manual and two 360K diskettes. Logitech & ITC versions, \$64 each. Both versions for \$84. Check/MC/VISA. Send for FREE documentation and demo disk to find out more.

**PMI** 4536 S.E. 50th Portland, OR 97206 (503) 293-7706  
MCI Mail: PMI; Compuserve: 74706,262

## CP/M, MS-DOS EPROM PROGRAMMING SYSTEM

2708  
2758  
2516  
2716  
2732  
2764



2732A  
2764A  
27128  
27128A  
27256  
27CXX

- SOFTWARE AVAILABLE FOR CP/M-80, CP/M-86 AND MS-DOS SYSTEMS  
- STAND ALONE BOARD - ELECTRONIC SWITCHING OF EPROM TYPES  
- USES 24 VOLT XPMR FOR POWER - ALL SUPPLIES/TIMING ON BOARD  
- NO PERSONALITY MODULES TO BUY - LARGE COMPREHENSIVE MANUAL

### \*\* PARALLEL PRINTER INTERFACE \*\*

CONNECTS TO ANY PARALLEL PRINTER INTERFACE - USES 8 OUTPUT DATA BITS AND ONE INPUT DATA BIT (BUSY LINE). BUSY LINE IS A HIGH SPEED SERIAL INPUT. FULL EPROM READING AND PROGRAMMING. UNIT MAY ALSO BE CONNECTED TO ONE 8 BIT INPUT/OUTPUT PORT.

### \*\* CONTROL PROGRAM COMMANDS \*\*

- PROGRAM EPROM(S) FROM DISK - SAVE EPROM(S) TO DISK  
- READ DISK FILE INTO RAM - PROGRAM EPROM(S) FROM RAM  
- READ EPROM(S) INTO RAM - COMPARE EPROM WITH RAM  
- VERIFY EPROM IS BRASED - COPY EPROM  
- DISPLAY/MODIFY RAM - (MONITOR MODE) WITH 11 SUB COMMANDS  
FILL-DUMP-XFER-EXAMINE-MODIFY-BIAS-PROGRAM-VERIFY, ETC.)

ASSEMBLED & TESTED UNIT WITH COMPLETE DOCUMENTATION AND SOFTWARE ON DISKETTE ---> \$199  
PARTS KIT WITH SOFTWARE AND DOC->\$179. PCB, SOFTWARE & DOC->\$69  
SOFTWARE ON 8 & 5 1/4 DISK FOR KAYPRO, OSBORNE, IBM & OTHER PMTS

TO ORDER SEND CHECK, MONEY ORDER, WRITE OR CALL

**ANDRATECH**  
P.O. BOX 222  
MILFORD, OHIO 45150  
(513) 752-7218

CALL OR WRITE FOR MORE INFORMATION --- ADD \$4.00 FOR SHIPPING  
OHIO RES. ADD 5.5% TAX --- VISA/MC. ACCEPTED --- \$3.00 FOR COD



## Metamagical Themas

If you haven't read a Douglas Hofstadter book or article, you're missing out.

His Pulitzer Prize winning "Godel, Escher, Bach" turned heads back in '79, with a blend of philosophy, wit, and humor encompassing a range of subjects from the structure of DNA, self-reproductive art, incompleteness theorems, the Turing machine, and artificial intelligence to fugues, counterpoint, and poetry (including limericks).

His most recent book, "Metamagical Themas," is equally intriguing, despite an almost presumptuous subtitle, "Questing for the Essence of Mind and Pattern."

Three chapters in particular should appeal to the would-be (or already groomed) computer guru — LISP: Atoms and Lists, LISP: Lists and Recursion, and LISP: Recursion and Generality.

Together they compose a tidy and stimulating introduction to LISP, A.I. (from a programmer's perspective), and recursion. Here's a bit of his wit in an explanation and solution of the Towers of Brahma (or Hanoi) puzzle.

"In the great Temple of Brahma in Benares, on a brass plate beneath the dome that marks the Center of the World, there are 64 disks of pure gold which the priests carry one at a time between three diamond needles according to Brahma's immutable law: No disk may be placed on a smaller disk. In the Beginning of the World, all 64 disks formed the Tower of Brahma on one needle. Now, however, the process of transfer of the tower from one needle to the other is in midcourse. When the last disk is finally in place, once again forming the Tower of Brahma but on a different needle, then will come the End of the World, and all will turn to dust.

"Earlier I pointed out that recursion is evident enough: to transfer 64 disks from one needle to another (using a third), it suffices to know how to transfer 63 disks from one needle to another (using a third).

"Now someone might complain that I left out all the hard parts: magically assuming an ability to move 63 disks! So it might seem, but there's nothing magical about it. After all, to move 63, you merely need to know how to move 62. And to move 62, you merely need to know how to move 61. On it goes down the line, until

# QUALITY SOFTWARE YOU CAN AFFORD!

**NEW Z80 Symbolic Debugger**

- Only \$49.95 plus shipping.
- Screen oriented with a simultaneous display of instruction mnemonics, register, stack, and memory values.
- Breakpoints may be set on any combination of fixed memory address, register values and/or memory values.
- Uses Digital Research compatible SYM files.
- Supports Hitachi HD64180.

**Relocatable Z80 Macro Assembler**

- Only \$49.95 plus shipping.
- 8080 to Z80 Source Code Converter.
- Generates Microsoft compatible REL files or INTEL compatible hex files.
- Compatible with Digital Research macro assemblers MAC & RMAC.
- Generates Digital Research compatible SYM files.
- Conditional assembly.
- Phase/dephase.
- Cross-reference generation.
- Full Zilog mnemonics.
- INCLUDE and MACLIB FILES.
- Separate data, program, common, and absolute program spaces.
- Supports Hitachi HD64180.
- Z80 Linker and Library Manager for Microsoft compatible REL files available as an add-on to Assembler.

**ATTENTION Turbo Pascal Users:**  
Assembler will generate in-line machine code include files.

**TO ORDER, CALL TOLL FREE:**  
**1-800-367-5134, ext. 804**  
For information or technical assistance:  
(808) 623-6361

Specify desired 5 1/4" or 8" format. Personal check, cashier's check, money order, VISA, MC, or COD welcomed.

## MITEK

Z80 is a trademark of Zilog, Inc. MAC and RMAC are trademarks of Digital Research, Inc. Turbo Pascal is a trademark of Borland International, Inc.

**PRICE LIST**

Z80 Macro Assembler: \$49.95  
Assembler, Linker, and Library Manager: \$95.00  
Manual Only: \$15.00

Z80 Symbolic Debugger: \$49.95  
Manual Only: \$15.00

Assembler, Linker, Library Manager, and Debugger: \$134.95

*Include \$5 for shipping and handling.*

P. O. Box 2151  
Honolulu, HI 96805

Include \$5 for shipping and handling.

you bottom out at the embryonic case... Now, I'll have to admit that you have to keep track of where you are in the process, and that may be a bit tedious — but that's merely bookkeeping. In principle, you could actually carry out the process — if you were bent on seeing the world end!"

It's 800-plus pages of structure and strangeness from Basic Books. \$24.95 in H/C.

### Pascal Runoff Take 3

Of course you're not going to believe it, but we omitted another Pascal Runoff entrant.

Frank Jones was indeed a bonafide participator, and his program, NFILST, was considered and judged along with the 126 other entries.

It's just that, well, we have serious trouble keeping up with slips of paper (especially ones with names on them) around here. (Obviously, no one submitted a Pascal Runoff Contestant Name Preservation and Organization Program.)

Sorry, Frank.

### The Visible Computer: 8088

This is it — the best 8088 assembly language tutorial we've encountered (almost too good to be true).

"The Visible Computer: 8088" is a program and a book. The program

(TVC, a sophisticated debugger) simulates the PC's processor, taking you inside the 8088 as it executes programs. An attractive display of a half dozen windows allows you to monitor CPU registers, memory, flag status, and instruction execution simultaneously.

A variable step rate function lets you determine the rate of execution (so you don't have to miss an iota of micro code). And a command line allows you to interrupt and direct simulation with a keystroke.

The book is an excellent 350-page introductory (assumes nothing) text written with wit and style (it even makes segment addressing sound easy).

And once you've gotten the hang of assembler, you can use TVC to debug sophisticated programs (most of the commands and capabilities are compatible with DEBUG).

In short, "The Visible Computer: 8088" is a winner; we highly recommend it.

For more info contact —  
Software Masters Costs \$79.95  
2714 Finfeather  
Bryan TX 77801 409-822-9490

And that, friends, is all the Tidbits fit to bite into this issue.





# WANT ADS

The following folks are reaching you for only 20 cents per word. If you would like to reach the same audience, send your words and 20 cents for each to Micro Cornucopia.

**\$25 Keyboards** for computer builders - 83 keys, full ASCII; upper/lower case, all control characters, numeric pad, caps-lock, repeat, self-test! Brand new, hundreds sold to builders of Apples, Big Boards, Xerox 820s. Parallel output, positive TTL logic, strobe. Uses only 106mA of +5 volts. Custom case available. 90 day warranty unmodified. Keyboard \$25. Documentation (21 pgs.) cable package \$5. Spare custom CPU/ROM \$4. All 3 (\$34 value) \$30. UPS additional, 5 lbs. Call/SASE for detailed spec sheet. Electrovalue Industrial Inc., Box 376-MC, Morris Plains, NJ 07950. (201) 267-1117. TF

**Public Domain UG Software Rental:** CP/M UG Vol 1-92 on 46 8" floppies, \$45. SIG/M UG Vol 1-246 on 108 8" floppies, \$155. PICONET Vol 1-34 on 17 8" floppies, \$25. Pascal-Z UG Vol 1-30 13 8" floppies, \$25. KUG (Charlottesville) 55 disks, \$65. IBM-PC SIG 1-454 PC-DOS, \$475. PC-Blue 1-175 MS-DOS, \$185, directory disks \$5 PP. Also available on 209 5.25" formats. Rental is for 7 days after receipt with 3 more days grace for return. Credit cards accepted (preferred). Downloading-disk format conversions. Call. User Group Software Automatic Update Service, \$7.50 per 2 volume set PP. 619-727-1015 info. 24 hrs. 619-941-0925 9-5. National Public Domain Software Center, 1533 Avohill, Vista, CA 92083. TF

**TBKUG/DataCOM Super Systems (tm)** proudly announces the arrival of the new SUPER System!! The remote multi-user database for the novice, the semi-pro, or seasoned hacker. Let your modem be your guide to the most current public domain for CP/M-80, MS/PC-DOS, TurboDOS, Turbo Pascal, Big Board, MEX, ZCPR3, CP/M-86, BASIC, Assembler, Kaypro, WordPro, and many other special interests. We are open 24 hours a day and accept 300, 1200, and 2400 baudrates. This is a multi-user TurboDOS-based S-100 system featuring state of the art equipment and dedicated to serving all your telecommunications needs. Membership fees are: \$35 per year for standard access or \$125 per year gets you a VIP membership that includes UNLIMITED system usage and a monthly update disk of CP/M software in Kaypro format. Join over 700 other users who have made the "right" choice. Fees are refundable if you're not satisfied within the first 30 days! Contact Steve Sanders at: TBKUG/DataCOM, 2643 Cedarview Court, Clearwater, FL 33519, or call (813) 791-1454/55 by modem and download an application. 30

**Drive Cleaning Kit Sale!** 8" only, floppyclene with chemicals and carriers. Reg. \$69.95, now \$20 each + \$2 postage. Datatype Head Cleaning System, Reg. \$11.95 and extra head cleaning pack (10) Reg. \$20 - now just \$6 + \$2 postage. National Public Domain, 1533 Avohill Dr., Vista, CA 92084. 33

**"Getting Started With CBASIC"** - Workbook, tutorial style for beginners/intermediates in this powerful language. Fundamentals through file handling, user functions, etc. Ends confusion, frustrations! Only \$25/U.S. Four Corners Press, Hanover, MA 02339. 30LI

**Turbo Cheques!** We have developed the most comprehensive personal checkbook management program on the market today. Professionally developed, easy to use, supports color, hard disks, prints checks, security controls, extensive screen displays and reports. 125+ page User's Manual. A real value for only \$39.95. Makes balancing your checkbook every month a breeze. If not convinced, try our Demo Disk for only \$5.00! You'll be pleasantly surprised and you can't lose. If you don't like the Demo, we will refund your money. The Demo price will be credited towards the full version. IBM-PC/XT. CompuTech, Box 7000-309, Redondo Beach, CA 90277. 30FR

**Computer Doctor** - Will repair your SICK computer, drive, etc. Specializing in CP/M, Radio Shack, and IBM machines. Can also program EPROMS. SASE for more info. (314) 243-7160. Computer Doctor, Rt. #2, Box 190, Jackson, MO 63755. 30KR

**CP/M 68K Macro Assembler** - Native Assembler for CP/M 68K. About 3 times faster than DRI's. Full Macro facilities, and produces executable files directly, or files that work with linker. Will also assemble files produced by CP/M 68K C compiler. Disk formats: CP/M 8", MS-DOS, many 5". Price \$129. ppd. Texas residents add 5.125% tax. Manual \$12 ppd. VISA, MC accepted. Computers Plus, % ICC Software, 314 Barnett Dr., Weatherford, TX 76086. Phone 10-6 CST (817) 599-0832. 30

**For Sale.** Cromemco TUART \$100. PMMI-103 modem, works to 600 baud \$125. Integrand X/5 \$125. ADC super-slave 6MHz 128K \$425. ICD XL dual slaves 8MHz Z80 256K/user OR 6MHz HD64180 512K/user with drivers \$725. All working! All Marshall (219) 665-9945. 30

**For Sale.** Superbly crafted BBI system, 5MHz complete w/ cabinet, keyboard, monitor, parallel and serial drivers, as well as EPROM burner w/software. Will give purchaser CP/M and MP/M, RMAC Pascal, and BASIC assembler (all original diskettes with manual). Also, a collection of 19 Micro C user disks. All this for only \$600 US or best offer. C. Phaneuf, 972 Guillaume Boisset, Cap-Rouge P.Q. Canada G1Y 1Y9. Eves (418) 658-1086. 30

**Big Board I Hard Disk Do-it-Yourself Manual.** Why pay big bucks? Includes schematics for SCSI disk controller adaptor, Z80 source code for monitor ROM and BIOS modifications, plain English detailed descriptions of all software and hardware, construction photos, and where to buy controllers and disks cheap. I did it, you can too. This is no kludge scab-on, but a built-in, CP/M-transparent subsystem. Manual: \$25. Two-chip ROM set also available: \$25. Phil Mattison, 1701 E. Todd, Tempe, AZ 85283. (602) 897-0293. 30

**For \$12 postpaid,** I will send you the neatest "gadget" you can have for your small-screen Kaypro. MAGGIE! is a flat plastic lens that slips into place in front of your screen (without tools) and gives you the effect of a 12 inch screen. Virtually no distortion, and no more glare from ambient light than your regular screen. Money back guarantee of satisfaction. Kay-Pal, 107 Hudson Dr., Hendersonville, NC 28739. Allow three weeks for delivery. 30

**Kaypro Motherboard** - Kaypro 4-83 motherboard with Pro-8 ROM. Tested and operational. \$89.95. Call Joel Burke (803) 427-2831. 30

**Affordable Engineering Software** for CP/M-80, PC-DOS, MS-DOS, and TRS-DOS. Free 52-page catalog. Low cost pen plotter driver, transfer function analysis, scientific calculator, communications design spreadsheet, graph printing, circuit analysis, signal processing, mathematics, root locus, active filter design, thermal analysis, and report proofreader programs. BV Engineering, 2200 Business Way, Suite #207, Riverside, CA 92501. (714) 781-0252. VISA and MasterCard accepted. 35

**The Lost Dutchman's Gold Mine** is a subscription database system specializing in public domain software for CP/M-80 & MS(PC)-DOS. Whether your interests are Turbo Pascal, dBASE, assemblers, utilities, communications or business applications, the Gold Mine offers the most current selection in the western U.S. Regular subscriptions are \$25 per year. Contact The Lost Dutchman's Gold Mine, P.O. Box 23937, Phoenix, AZ 85063, or call (602) 247-2880 to download an application. Money Back Guarantee! 31

**Flight Plan Program** with NAV-AID database covering entire U.S. "Install" for your airplane's performance. CP/M or IBM. Supports user entered "custom" waypoints. Completely menu driven. Thoroughly documented. \$29.95. For program description send SASE to NAVI-GATE, 3051 Shirley Dr., Newbury Park, CA 91320. 32

**Keyboards** - Full ASCII, Upper and Lower case, all control characters, TTY lock, TTL level parallel interface, +5 volt, reset/ page key and break key brought out to separate TTL outputs. Direct connect to Xerox 820-II and Big Board computers, schematic included, cables available. Brand new, high quality units - \$14.94 plus \$3 shipping. These won't last long at this price. Send Cashiers Check or Money Order to Keyboards Unlimited, P.O. Box 921, Hillsboro, OR 97123. 30

# T-SHIRTS



## ORDER YOUR MICRO C T-SHIRT TODAY!

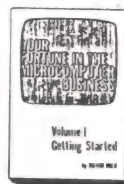
These user-friendly cream-colored shirts are formatted in mahogany border with black enhanced mode design. The fully integrated system is compatible to size S, M, L, and XL, for only \$6.95 ppd. (\$8.50 all foreign).

# BOOKS



## Inside CP/M

By David Cortesi  
\$27.95 (US, Can, Mex)  
\$37.95 (Other Foreign)  
This is one of the best books on CP/M for everyone, users and programmers. It's our reference here at Micro C.



## Your Fortune in the Micro Computer Business

By Victor Wild  
\$26.45 (US, Can, Mex)  
\$36.45 (Other Foreign)  
This is the best, most complete collection of working for yourself information that we've found.  
2 volumes.



## The Small C Handbook

By James Hendrix  
\$17.95 (US, Can, Mex)  
\$22.95 (Other Foreign)  
If you really want to solve the mysteries of the Small C compiler (or compilers in general) you'll want this book.

**MICRO CORNUCOPIA**  
P.O. Box 223  
Bend, Oregon 97709



**SOG V**  
(Semi-Official Get-Together)  
July 24th - July 27th



See yourself in Bend  
this summer for  
three days of  
technical forums  
among the pines  
and junipers  
on the campus  
of Central Oregon  
Community College

### Thursday, July 24th SOG KICK-OFF

Once again we're kicking off the SOG with white water rafting followed by the kick-off cookout. If you're interested in safe thrills then sign up for one of these professionally guided trips.

- All day - includes transportation from the college, box lunch, 4 1/2 hours on the lower Deschutes River, and the Kick-off Cookout.
- 2 1/2 hour - includes transportation from the college, 1 1/2 hours on the river, and the cookout.

Raft trip prices will be in the SOG registration packet.

### Friday - Sunday July 25th - 27th FREE TECHNICAL CONFERENCE

You'll meet the people who are writing the compilers (C, Modula, Pascal) and the interpreters (PROLOG), who are designing the boards (32032, 68020 . . .), and who are writing the articles.

- George Morrow (Morrow Computers) will be talking about computer directions.
- Trevor Marshall (Definicon Systems) will be talking in depth about the 68020.
- Michael Frieling (AI researcher) will discuss designing expert systems tools.
- Allyn Franklin (Drive Masters) will run a workshop on drive aligning.
- And much more! The schedule expands daily.

### TO REGISTER

Call or write for the SOG registration packet.

**DORM** The one dorm has 50 rooms which hold 2 people each. A room for Wednesday night through Sunday noon is only \$80 (that's \$40/person). If you have your heart set on a dorm room (the center for late-night discussions) call and tell us right away.

### MICRO CORNUCOPIA

P.O. Box 223  
Bend, Oregon 97709  
(503) 382-5060, 9-5, M-F

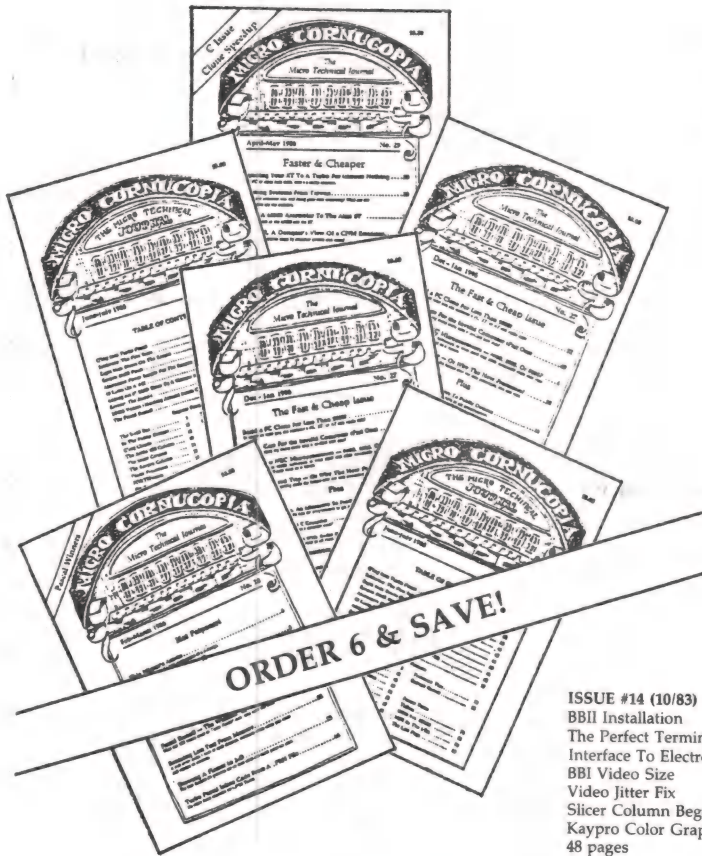


# Complete Your Education

If you're not working with a full set, fill out your collection of Micro C today.

## BACK ISSUES OF MICRO C.

Only \$1.50 each when you order 6 or more  
All Foreign \$2.00 each for 6 or more  
(includes surface postage)



**ISSUE #1 (8/81)**  
Power Supply  
RAM Protection  
Video Wiggle  
1/2 PFM.PRN  
16 pages

**ISSUE #2 (10/81)**  
Parallel Print Driver  
Drive Motor Control  
Shugart Jumpers  
Program Storage Above PFM  
1/2 PFM.PRN  
16 pages

**ISSUE #3 (12/81)**  
4 MHz Mods  
Configuring Modem 7  
Safer Formatter  
Reverse Video Cursor  
FORTHwords Begins  
16 pages

**ISSUE #4 (2/82)**  
Keyboard Translation  
More 4 MHz Mods  
Modems, Lync, and SIOs  
Undoing CP/M ERASE  
Keyboard Encoder  
20 pages

**ISSUE #5 (4/82)**  
Word Processing  
Two Great Spells  
Two Text Editors  
Double Density Review  
Scribble, A Formatter  
20 pages

**ISSUE #6 (6/82)**  
BBI EPROM Programmer  
Customize Your Chars  
Double Density Update  
Self-Loading ROM  
Terminal In FORTH  
24 pages

**ISSUE #7 (8/82)**  
6 Reviews Of C  
Adding 6K of RAM  
Viewing 50 Hz  
On Your Own Begins  
24 pages

**ISSUE #8 (10/82)**  
Drive Maintenance  
Interfacing Drives  
Installing A New BIOS  
Flippy Floppies  
C'ing Clearly Begins  
Xerox 820 Begins  
28 pages

**ISSUE #9 (12/82)**  
BBI EPROM Program  
Relocating Your CP/M  
Serial Print Driver  
Big Board I Fixes  
Bringing Up WordStar  
Cheap RAM Disk  
32 pages

**ISSUE #10 (2/83)**  
Saving A Flakey Disk  
Hooking Wire to BBI  
The Disk I/O Doctor  
JRT Fix  
Serial Board Interface  
Pas. Procedures Begins  
36 pages

**ISSUE #11 (4/83)**  
BBI Expansions  
BBI Details  
Dyna, RAM Disk Review  
Easier Reverse Video Cursor  
Planning A Review  
Kaypro Column Begins  
36 pages

**ISSUE #12 (6/83)**  
256K For BBI  
Bringing Up BBI  
dBase II  
Look At WordStar  
Double Sided Drives For BBI  
Packet Radio  
5 MHz For Kaypro  
40 pages

**ISSUE #13 (8/83)**  
CP/M Disk Directory  
More 256K FOR BBI  
Mini Front Panel  
Cheap Fast Modem  
Nevada COBOL Review  
BBI Printer Interface  
Kaypro Reverse Video Mod  
44 pages

**ISSUE #14 (10/83)**  
BBI Installation  
The Perfect Terminal  
Interface To Electronic Typewriter  
BBI Video Size  
Video Jitter Fix  
Slicer Column Begins  
Kaypro Color Graphics Review  
48 pages

**ISSUE #15 (12/83)**  
Screen Dump Listing  
Fixing Serial Ports  
Playing Adventrue  
SBASIC Column Begins  
Upgrading Kaypro II to 4  
Upgrading Kaypro 4 to 8  
48 pages

**ISSUE #16 (12/84)**  
Xerox 820 Column Restarts  
BBI Double Density  
BBI 5'8" Interface Fix  
Kaypro ZCPR Patch  
Adding Joystick To Color Graphics  
Recovering Text From Memory  
52 pages

**ISSUE #17 (4/84)**  
Voice Synthesizer  
820 RAM Disk  
Kaypro Morse Code Interface  
68000-Based System Review  
Inside CP/M 86  
56 pages

**ISSUE #18 (6/84)**  
Kaypro EPROM Programmer  
I/O Byte: A Primer  
Kaypro Joystick  
Serial To Parallel Interface  
Business COBOL  
60 pages

**ISSUE #19 (8/84)**  
Adding Winchester To BBI  
6 MHz On The BBI  
Bulletin Boards  
Track Buffering On Slicer  
4 MHz For The 820-I  
64 pages

**ISSUE #20 (10/84)**  
HSC 68000 CO-Processor  
DynaDisk For The BBI  
Serial Printer On BBI Sans SIO  
Cheap & Dirty Talker For Kaypro  
Extended 8' Single Density  
72 pages

**ISSUE #21 (12/84)**  
Analog To Digital Interface  
Installing Turbo Pascal  
Low Intensity BBI Video  
Turbo Pascal, The Early Days  
80 pages

**ISSUE #22 (2/85)**  
Xerox 820-II To A Kaypro-8  
Sound Generator For The STD Bus  
Reviews Of 256K RAM Expansion  
In The Public Domain Begins  
88 pages

**ISSUE #23 (4/85)**  
Automatic Disk Relogging  
Interrupt Driven Serial Printer  
Low Cost EPROM Eraser  
Smart Video Controller  
Review: MicroSphere RAM Disk  
Future Tense Begins  
86 pages

**ISSUE #24 (6/85)**  
C'ing Into Turbo Pascal  
8' Drives On The Kaypro  
48 Lines On a BBI  
68000 Versus 80X86  
Soldering: The First Steps  
88 pages

**ISSUE #25 (8/85)**  
Why I Wrote A Debugger  
The 32-Bit Super Chips  
Programming The 32032  
Modula II  
RS-232C: The Interface  
104 pages

**ISSUE #26 (10/85)**  
Inside ZCPR3  
Two Megabytes On DSI-32  
SOG IV  
The Future Of Computing  
MS-DOS In The Public Domain  
Graphics In Turbo Pascal  
104 pages

**ISSUE #27 (12/85)**  
Build An \$800 Clone  
Fixing Your Own System  
NEC V20 Processor  
Selling Your Own Software  
Inside Small C Compiler  
104 pages

**ISSUE #28 (2/86)**  
Pascal Runoff Winners  
Rescuing Lost Text From Memory  
Introduction To Modula-2  
First Look At Amiga  
Inside The PC  
104 pages

**ISSUE #29 (4/86)**  
Speeding Up Your XT  
Importing Systems From Taiwan  
Prototyping In C  
C Interpreters Reviewed  
Benchmarking The PCs  
104 pages

## BACK ISSUES

U.S. Regular Price .....\$3.00 each  
6 or more 1/2 price .....\$1.50 each

Regular Foreign Price (air mail) .....\$5.00 each  
6 or more (including Canada) .....\$2.00 each  
(surface postage)



BD Software, Inc., maker of the original  
CP/M-80 C Language Development  
System, knows

# Time is precious

So the compilation, linkage and execution speeds of BDS C are the fastest available, even (especially!) on floppy-based systems. Just ask any user! With 15,000+ packages sold since 1979, there are *lots* of users . . .

*New!* Ed Ream's RED text editor has been integrated into the package, making BDS C a truly complete, self-contained C development system.

Powerful original features: CDB symbolic source-level debugger, fully customizable library and run-time package (for convenient ROM-ing of code), XMODEM-compatible telecommunications package, and other sample applications.

National C User's Group provides direct access to the wealth of public-domain software written in BDS C, including text editors and formatters, BBS's, assemblers, C compilers, games and much more.

Complete package price: \$150.  
All soft-sectored disk formats, plus Apple CP/M, available off-the-shelf. Shipping: free, by UPS, within USA for *prepaid* orders. Canada: \$5.  
Other: \$25. VISA, MC, COD, rush orders accepted.

**BD Software, Inc.**

BD Software, Inc.  
P O Box 2368  
Cambridge MA 02238  
617 • 576 • 3828



## ADVERTISER'S INDEX

Advanced Concepts Engineering . . . . . 29  
Ampro Computers . . . . . 90, 91  
Andratech . . . . . 98  
Austin Codeworks . . . . . 62

BD Software . . . . . 103  
Biegun & Assoc. . . . . 89  
Bakkers, Andy . . . . . 61  
Borland International . . . . . Inside Front Cover

Carolina Engineering Labs . . . . . 37  
Cascade Electronics . . . . . 75  
C Contest . . . . . 67  
C.C. Software . . . . . 83  
Computer Helper Industries . . . . . 80  
Computer Journal . . . . . 74  
Computer Surplus Store . . . . . 82  
Computing Technology . . . . . 81  
CompuView . . . . . 17  
Craig's Computers . . . . . 87

Data Desk . . . . . Back Cover  
Definicon . . . . . 69  
Digital Dynamics . . . . . 89  
Digital Research . . . . . 79

Echelon, Inc. . . . . 46, 58  
EcoSoft . . . . . 84  
Emerald Microware . . . . . 43, 45  
Epic Sales . . . . . 11  
ERAC Co. . . . . 16  
E2I Computer . . . . . 79

Fletcher, Don . . . . . 31  
Halted Specialties . . . . . 95  
Hawthorne Technology . . . . . 85  
High Tech . . . . . 51  
Holliston Computer . . . . . 5

Integrand . . . . . 76

Kamasoft . . . . . 35  
Kenmore Computer Technologies . . . . . 46  
KYSO Technology . . . . . 66

Laboratory Microsystems . . . . . 62  
Logitech, Inc. . . . . Inside Back Cover

Manx Software . . . . . 39  
Microcomputer Systems Consultants . . . . . 38  
Micro Cornucopia . . . . . 93, 100-102  
Micro Methods . . . . . 57  
Micromint . . . . . 85  
Micro Motion . . . . . 23  
Microprocessors Unlimited . . . . . 76  
MicroSphere . . . . . 92  
Micro Supply . . . . . 24, 25  
Miken Optical Co. . . . . 76  
Mitek . . . . . 99

National Public Domain Software . . . . . 59

Oliver Computers . . . . . 42

PC Tech . . . . . 1  
Periphco . . . . . 97  
PMI . . . . . 98  
Poor Person Software . . . . . 46

Qua Tech . . . . . 27

SBC Mart . . . . . 81  
Second City Software . . . . . 47  
Servo Computers . . . . . 57  
Sky High Co. . . . . 34  
Slicer . . . . . 39  
Soft Advances . . . . . 56  
Source Information . . . . . 15  
Stelcor Inc. . . . . 89

Tomorrow's Computing . . . . . 7

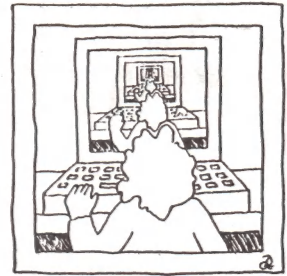
Unified Software . . . . . 62  
United Products . . . . . 63

Western Wares . . . . . 66



(((((Recursion))))))

By Gary Entsminger



## Recursion In Turbo Pascal And PROLOG

When a function (or procedure) invokes itself we call the process recursion. A simple, and fundamental, application is a function for calculating the factorial of a number.

A factorial is the product of a number times itself minus 1, times itself minus 1, times itself minus 1, etc., down to 1. For example, 6!(factorial) is —

6 \* 5 \* 4 \* 3 \* 2 \* 1

or 720. (It adds up quickly.)

If we look closer, we see that 6! is also equal to 6 \* 5!. And 5! is equal 5 \* 4!, etc. Or —

$N! = N * (N-1)!$

In other words, to solve  $N!$ , we call the factorial function substituting "N-1" for "N" until we reach the limiting condition,  $N-1 = 1$ .

### In Pascal

Let's look at the recursive function in Turbo.

```
Function Factorial(N:integer):integer;
Begin
  If N > 1 then
    Factorial := N * Factorial(N-1)
  else Factorial := 1
End;
```

### System Perspective

From the computer's perspective, when a procedure (or function) calls another procedure, its formal parameters and local variables are pushed onto the stack, along with the return address of the calling procedure. (The system needs to know where to return control after it's finished handling the procedure.) Then control is passed to the called procedure.

When the procedure has finished executing, it retrieves the return address from the stack and then pops the variables and formal parameters.

Control is then returned to the calling procedure.

If a procedure calls itself (recursion), the same pushing and popping occurs. Each time the procedure calls itself, it pushes another set of variables and parameters onto the stack. Eventually, if the procedure calls itself too many times, the stack overflows (fills to the point that it starts writing over other data) and crashes the system.

It's always possible, in principle, to find a non-recursive solution, and although the non-recursive solution may be slightly more efficient (sometimes), it can obscure the algorithm. For example, we could use iteration to solve a factorial —

```
Begin
  p:= 1;
  While n > 1 Do
    p:= n * p;
    n:= n -1
End;
```

The obscurity becomes more obvious in complex problems, such as the 8 Queens solution, the Quicksort (invented by C.A.R. Hoare), and in programs to generate permutations (see "Programming In Modula-2" by Niklaus Wirth). (Obvious obscurity, an oxymoron perhaps?)

### In PROLOG

A logic programming language, PROLOG (for PROGRAMming in LOGic) relies (you might say, thrives) on recursion, since it lacks primitive functions for iteration. Let's examine the factorial function in the two principle PROLOG syntaxes — micro-PROLOG and Edinburgh.

First in micro-PROLOG —

```
1 factorial 1
x factorial y if
  1 LESS x &
  SUM(x1 1 x) &
  x1 factorial y1 &
  TIMES(x y1 y)
```

We define a fact (the factorial of 1 is 1) and a rule (x factorial y if...) for finding factorials greater than 1.

If you're unfamiliar with PROLOG, try reading the function this way —

Given x, to find y such that x factorial y, if  $x=1$ ,  $y=1$  (1 factorial 1) or if  $x > 1$  (1 LESS x), subtract 1 from x to get x1 (SUM(x1 1 x)), and find y1 such that x1 factorial y1, and multiply x by y1 to get y.

Or in other words, call the factorial function recursively until  $x = 1$ .

In the Edinburgh syntax —

```
factorial(1,1).
factorial(X,Y) :-
  X > 1,
  Z is X - 1,
  factorial(Z,A),
  Y is A * X.
```

gives the same result.

### More Recursion

Although recursion has been around as an idea for centuries (an obsolete definition in the O.E.D. defines it as "a backward movement"), the increasing popularity of PROLOG (and descriptive programming in general) will no doubt lead to more and more discussions about it (which will no doubt lead to more and more discussions about it).

Recursion is a powerful technique for describing structures and programs succinctly, now affordable on microcomputers thanks to the larger memories currently available on PCs.

For more information about recursion and PROLOG in general, see "Programming in PROLOG" by Clocksin and Mellish and "micro-PROLOG: Programming in Logic" by Clark and McCabe.



# This is the Modula-2 compiler everybody's been waiting for...

Especially Turbo Pascal users!

## LOGITECH MODULA-2/86

Now, you can cross the bridge to Modula-2 with ease.

This is Modula-2 at its *absolute* best. It's a fully integrated development environment that takes into account what you need as a programmer. Without leaving the Editor, you can call the compiler, linker and utilities.

With Logitech's Modula-2, you'll have the ability to edit several files at once, comparing, window to window, various code modules. You can even move from window to window compiling, linking, debugging and running.

The compiler has the kind of power and room to breathe that you really need in today's complex applications. It is as *easy* to use as Turbo Pascal, without your programs being limited to 64K of code.

At your command will be the libraries of modules that make Modula-2 a programmer's dream. It has essentially the same structure as Pascal with the major addition of a library organization of code modules that allow you to put together programs on a solid, block-by-block, foundation of proven code.

Whether you're working with a module of your own making, or one of the many in our library, you'll find the system by which each module is identified, described and stored an organizational masterpiece. And that's at the heart of Modula-2.

Underneath the sophisticated system is a Modula-2 compiler that is the result of years of development and proven use in industry. We run on the Vax\*, and we run on the IBM PC. And the code is portable—from one to the other.

*Best of all... you can have it right now!*

**Logitech Modula-2/86** Complete with Editor, Run Time System, Linker, Cursor-positioning debugger, 8087 Software Emulation, BCD module, Logitech's extended library, Utility to generate standard .EXE files, Turbo Pascal (and standard Pascal, too) to Modula-2 translator (included without charge until 8/1/86), and much, much more!

**Logitech Modula-2/86 with 8087 support** Even if you haven't yet gotten an 8087 co-processor, you can still use this version.

**Logitech Modula-2/86 Plus** For machines with 512K or more. Takes advantage of the larger memory to increase compilation speed by 50%! Supports 80186 and 80286 as well as 8086 and 8088. Includes 8087 and 80287 support, too.

**Window Package** Now you can build true windowing into your Modula-2/86 code with ease, too. Very powerful and very full, yet only 15K in size. Features virtual screens, color support, overlapping windows and a variety of borders.

**Run Time Debugger** (source level) Much more powerful than just a symbolic RTD. Display source code, data, procedure call chain and raw memory. Set break points, assign values to variables, pinpoint and identify bugs in your source. The ultimate professional's tool!

**Utilities Package** Features a post-mortem debugger for static debugging. If a program you've written crashes at run time, the situation is frozen, and you can pinpoint, in source, the cause of the error and the data at that moment. Also includes a disassembler, a cross reference utility and a "version" utility that allows conditional compilation.

**Make Utility** Automatically selects modules affected by code changes for quick and minimal re-compilation and relinking. Even figures out dependencies for you.

**Library Sources** Source code for our major library modules is now available—for customization or exemplification.

**ROM Package** If you need to produce rommable code, call our 800 number for further information on this package.

To place an order call our special toll free number

**800-231-7717**

in California

**800-552-8885**

Special offer until 8/1/86!

includes

**\$89**

**Free! \$49.95 value Turbo Pascal translator!**  
Now, you can take your library with you!

Yes, I'd like to take the next logical step in programming.

Please send my copy of Logitech Modula-2/86 to the following address:

☐ VISA ☐ MasterCard ☐ Check Enclosed

Card Number \_\_\_\_\_ Expiration Date \_\_\_\_\_

Signature \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_ Phone (\_\_\_\_) \_\_\_\_\_

Here's the configuration I'd like:

And include the indicated items:

- |   |  |
|---|--|
| <input type="checkbox"/> Logitech Modula-2/86 \$89                    | <input type="checkbox"/> Window Package \$49                   |
| <input type="checkbox"/> Logitech Modula-2/86 \$129 with 8087 support | <input type="checkbox"/> Run Time Debugger \$69 (source level) |
| <input type="checkbox"/> Logitech Modula-2/86 Plus \$189              | <input type="checkbox"/> Utilities Package \$49                |
| Please add \$6.50 for shipping and handling.                          |  |
| <input type="checkbox"/> Make Utility \$29                            |  |
| <input type="checkbox"/> Library Sources \$99                         |  |

Total enclosed \$ \_\_\_\_\_  
(California residents, please add applicable sales tax)



### LOGITECH

LOGITECH, Inc.  
805 Veterans Boulevard  
Redwood City, California 94063  
Telephone (415) 365-9852

For European pricing, please contact:

LOGITECH SA  
Box 32, CH-1143 Apples, Switzerland  
Telephone 41 (21) 774545

Please call our 800 line for: ☐ Information on our \*VAX version ☐ Site License and University Discounts ☐ Dealer and Distributor information

\*Turbo Pascal is a registered trademark of Borland International



**RISK FREE  
30-DAY MONEY-BACK GUARANTEE**

NOW FOR YOUR IBM PC, XT, AT, AT&T, PC Jr. AND COMPATIBLES \*

# "THE PC HARDWARE BARGAIN OF THE YEAR"

Chuck Humble — Computer Editor

Both  
Hardware & Software

~~\$129~~<sup>95</sup>

*Introducing  
Offer* **\$99.95**



**OUR NEW PC 8700 AT-STYLE KEYBOARD AND  
BORLAND'S SUPERKEY® SOFTWARE**

**THE PC 8700 AT-STYLE KEYBOARD INCORPORATES EVERY IMPROVEMENT  
IBM DESIGNED INTO THEIR ADVANCED "AT" KEYBOARD. QUALITY SO  
GOOD, IT'S BACKED BY AN UNPRECEDENTED TWO-YEAR WARRANTY!**

Advanced design features include:

- Separate Numeric Keypad simplifies data entry
- Status Lights for Cap, Num and Scroll Lock helps eliminate typing errors
- Extra-wide Control and Return Keys for ease of use
- Return Key placed in "standard typewriter" position for touch typists
- Selectric layout for Office Standardization
- Positive Tactile Feedback
- Keyswitches rated for 50 million keystrokes
- Made in USA
- 2-Year Warranty

**BORLAND'S AWARD-WINNING SUPERKEY INCLUDED! GET THIS BEST-SELLING KEYBOARD ENHANCER SOFTWARE — VALUED AT \$69.95 — AS PART OF THIS AMAZING OFFER AND CAPTURE THE POWER OF MACROS!**

SuperKey's macro capability is remarkable. It literally turns a thousand keystrokes into one. Features include:

- Exclusive screen data Cut & Paste
- Screen Privacy and Protection
- Time & Data Stamping
- ProKey Compatibility
- Data Encryption
- Keyboard Lock
- Keyboard layout customization
- Integration with SideKick
- Pull-Down Menus
- On-Line Help and much, much more!

**Corporate and Institutional Purchase Agreements Available**

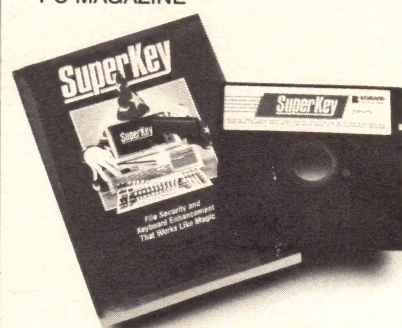
**datadesk**  
INTERNATIONAL

7650 Haskell Avenue Suite A  
Van Nuys, CA 91406

\* PC Jr., AT&T and Corona computers require adaptors available at a nominal fee. Call for pricing.

SuperKey and SIDEKICK are registered trademarks of Borland International, Inc. IBM, PC, XT and AT are registered trademarks of International Business Machines Corp.

INCLUDES BORLAND'S SUPERKEY  
AWARDED "BEST OF 1985" BY  
PC MAGAZINE



RETAILS ALONE FOR \$69.95

## CRITICS CHOICE

*"The-keyboard's construction is solid . . . also quick and responsive to the touch. It is ideal for anyone who wants to or has to replace their PC keyboard . . . At \$129.95 DataDesk's keyboard is a bargain. The PC 8700 keyboard with SuperKey for that price is a steal."*

Computer Shop Talk, 3-3-86

*"DataDesk International has designed a sturdy and handsome keyboard that has a tactile response . . . and bundled with SuperKey is the PC hardware bargain of the year."*

Charles Humble — Computer Editor, The Oregonian

**ORDER NOW — CALL TOLL FREE 800-826-5398; IN CA 800-592-9602**  
or fill out coupon and include check or credit card number and mail to DataDesk International, 7650 Haskell Ave., Suite A, Van Nuys, CA 91406.

## ***SuperMacro Keys***

PLEASE RUSH ME \_\_\_\_\_ KEYBOARD/SUPERKEY BUNDLES AT  
\$99.95 EACH. PLUS \$10 SHIPPING AND HANDLING IN THE U.S.A.

☐ ENCLOSED IS MY CHECK FOR \$109.99 FOR EACH BUNDLE  
(\$116.45 FOR CA RES. — SALES TAX INCL.)

☐ VISA ☐ MC NUMBER \_\_\_\_\_

EXP. DATE \_\_\_\_\_ SIGNATURE \_\_\_\_\_

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

COMPUTER TYPE & MODEL \_\_\_\_\_